

FISHER

VBS7500S

MODEL

SERVICE MANUAL

I. INTRODUCTION

In comparison with former models, the mechanism, circuitry, and many other aspects of this model have been significantly improved. The features of this model are listed below.

1. Weight Reduction

Compact, plastic mechanism parts and a plastic frame chassis are used. The plastic chassis for the reel drive section, the aluminium diecast cylinder chassis, the compact power transmission, and a reduction in the number of parts have made this unit much lighter and smaller.

2. Slim Design

The direct-drive motor has been built into the cylinder, the height of the cylinder assembly has been reduced, and an extremely thin direct-drive motor is used to drive the capstan. These and other developments have resulted in reducing the height of the recorder mechanism and giving this unit its slim dimensions.

Furthermore, all operation buttons have been arranged on the front panel in an entirely new design.

3. Improved Operation

Even the eject button, which was manually operated on previous models, has been improved and converted to full electronic soft-touch operation on this unit. And the microcomputer-controlled random access system and quick access mechanism (in which the tape does not have to be wound into the cassette during the FAST FORWARD mode or the REWIND mode) also make this unit very easy to use.

4. Reduced Power Consumption

- (1) The degree of integration in the IC circuitry has been increased.
- (2) A switching regulator that reduces power loss in the power circuit has been employed.
- (3) The head and capstan, driven by direct-drive motors, and the geared reel drive allow a reduction in the power required to drive the mechanism.

A combination of the above improvements and others has drastically reduced power consumption.

5. Improved Picture Quality

A 1H delay line is used in a new noise canceler for the video playback circuit. This noise canceler acts to shield the playback amplifier which processes the fine video head signal, and produces a low-noise, crisp, clear playback image.

6. Newly Developed Microcomputer

A newly developed microcomputer for the timer makes operation very easy and includes a 7-day/1-program timer. In addition, a newly developed microcomputer to control tape drive, electronic eject operation, and other operational improvements have been made.

7. Improved Serviceability

Fewer printed circuit boards are used, and fewer parts are connected to them. The number of screws used to attach printed circuit boards and parts is thereby reduced, and wiring is simplified. These improvements have greatly improved serviceability.

II. VIDEO CIRCUIT

A. PAL COLOUR VIDEO SYSTEM OUTLINE

1. PAL (Phase Alternation by Line) System

The CCIR1 system (U.K.) and the B & G system (West Germany, Holland, etc.) differ according to the transmission bandwidth. The number of scanning lines (625), the number of frames (25), and the interlace system (2:1) are the same for both systems; however, the bandwidth for each channel is 8 MHz in the British system and 7 MHz in the West German system, and the frequency bandwidths of the audio and chrominance subcarriers differ. (Refer to Fig. 2-1-1 for the transmission frequency spectrum.) In order to allow programs to be easily exchanged between the two systems, the chrominance subcarrier frequency, and also the colour signal modulation system, are exactly the same for both systems.

2. PAL System Composite Video Signal

The composite colour video signal E_M in the PAL system is prescribed by the following equation:

$$E_M = E'_Y + E'_U \sin WcT \pm E'_V \cos WcT \dots (1)$$

Provided that the luminance signal is:

$$E'_Y = 0.299 E'_R + 0.587 E'_G + 0.114 E'_B,$$

and the chrominance signal is:

$$E'_U = 0.493 (E'_B - E'_Y)$$

$$E'_V = 0.877 (E'_R - E'_Y)$$

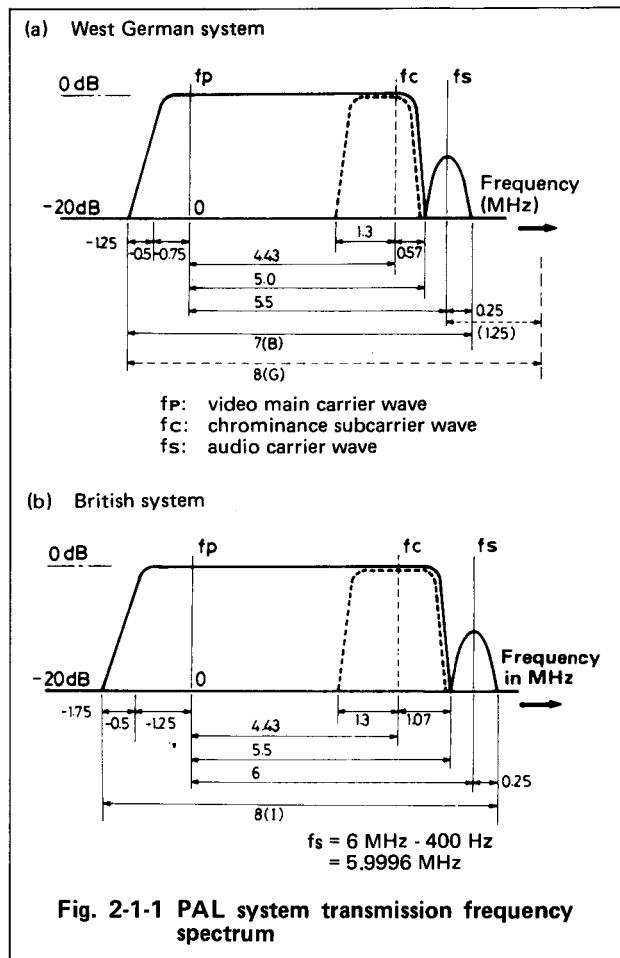
In the above equations, E'_R , E'_G , and E'_B represent gamma-corrected voltages.

The bandwidths for the chrominance signal and the luminance signal are:

$$\text{Chrominance signal: } 1.3 \text{ MHz} \leq 3 \text{ dB}$$

$$\text{Luminance signal: } 4 \text{ MHz} > 20 \text{ dB}$$

The (R-Y) signal and the (B-Y) signal are transmitted as the chrominance component of the PAL system, and for the (R-Y) signal, modulation is performed by inverting the phase 180° at every adjacent scanning line, particularly to compensate for phase distortions in the transmission path.



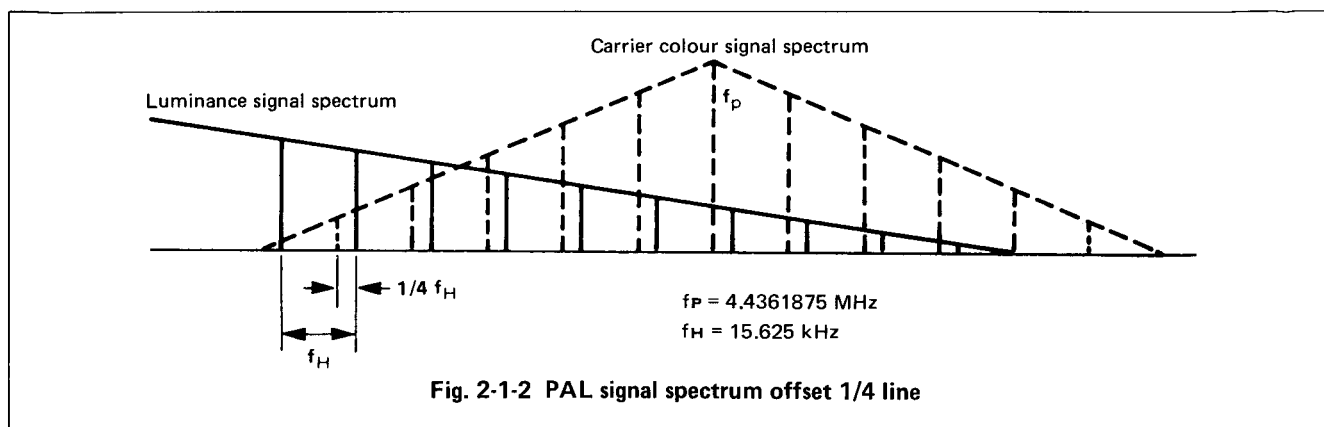
3. PAL System Subcarrier Frequency

The subcarrier frequency (f_P) in the PAL system utilizes a $1/4$ line-offset frequency whose relationship to f_H is:

$$f_P = (284 - 1/4)f_H + \frac{f_H}{625} \dots (2)$$

$$= 4.43361875 \text{ MHz} \quad (f_H = 15.625 \text{ kHz})$$

As shown in Fig. 2-1-2, the spectrum of the carrier colour signal being interleaved with the spectrum of the luminance signal at a distance of only $1/4 f_H$.



One scanning line was shown in Fig. 2-1-2; however, the interleaving position for the next scanning line shifts $1/2 f_H$ because of the phase change of the (R-Y) signal. The addition of $\frac{f_H}{625}$ (25 Hz) to equation (2) in the 625 line system is to make the movement of the subcarrier dot visually less conspicuous. It provides an improvement of 5 dB in the multiplex ratio of the detection limit.

4. Burst Phase

The burst phase corresponds to the phase change of the (R-Y) signal and, as shown in Fig. 2-1-3, is obtained at $\pm 135^\circ$ from the (B-Y) axis. The colour burst signal is inserted into the video signal in sequence at $+135^\circ$ and -135° from line 9 of field 1 and from line 8 of field 3.

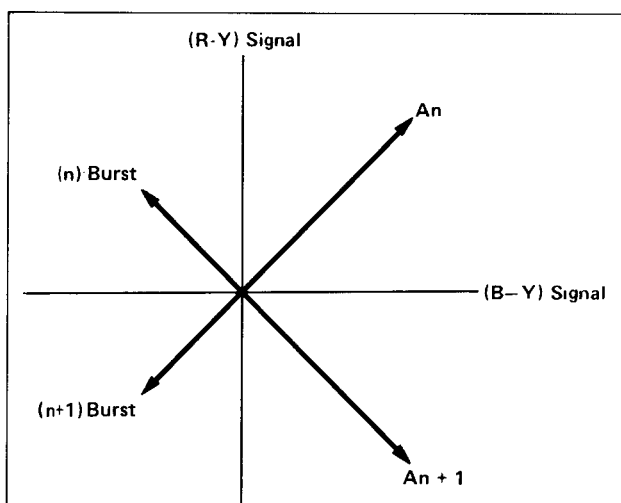


Fig. 2-1-3 Phase relationship of colour burst signals

B. BETACORD VIDEO RECORDING SYSTEM

1. Outline

In order to provide a home VCR system in which both the VCR unit itself and the video cassettes used are compact, lightweight, and moderately priced, high-density recording was developed. To make this high-density recording possible, a revolutionary recording system was adopted. The main features of this system are described herein.

a. Recording without a guard band

Recording without a guard band means that the guard band between the video tracks has been removed. When the guard band is removed, there is the problem of crosstalk from the adjacent track; however, the luminance signal places a $\pm 7^\circ$ azimuth between the two video heads, and, by using the azimuth loss occurring at high frequencies, the crosstalk is eliminated. Because the frequency of the chrominance signal is comparatively low and the azimuth loss is not so large, the crosstalk is eliminated in this revolutionary new colour recording system.

b. Short-wavelength recording

Because the diameter of the head drum is only 74.5 mm, the relative speed of the head to the tape is decreased to 5.83 metres per second, and the maximum recording wavelength (possible recording frequency) is reduced to 1.3 microns. In order to achieve this short-wavelength recording, the width of the video head gap has been reduced to 0.45 microns, and other improvements have been made, such as in the playback sensitivity in the shorter wavelength resulting from the quality of the magnetic recording materials (CrO_2 and $\text{Co-Fe}_2\text{O}_3$).

c. Narrow-track recording

In order to decrease the amount of tape used, the track width of the video head has been made narrower so that narrow-track recording with a track width of 32.8 microns can be done. Also, the tape speed has been reduced to 18.73 millimetres per second.

d. H alignment of the video tracks

Because of the necessity of providing this model with a "still frame" function during the PLAY mode, the H alignment between each of the tracks has been provided in order to eliminate the skew distortion during the still frame playback. To accomplish this the installation angle of the video head is regulated as shown in Fig. 2-1-4.

The H alignment is made by installing head A 0.288° later in relation to head B.

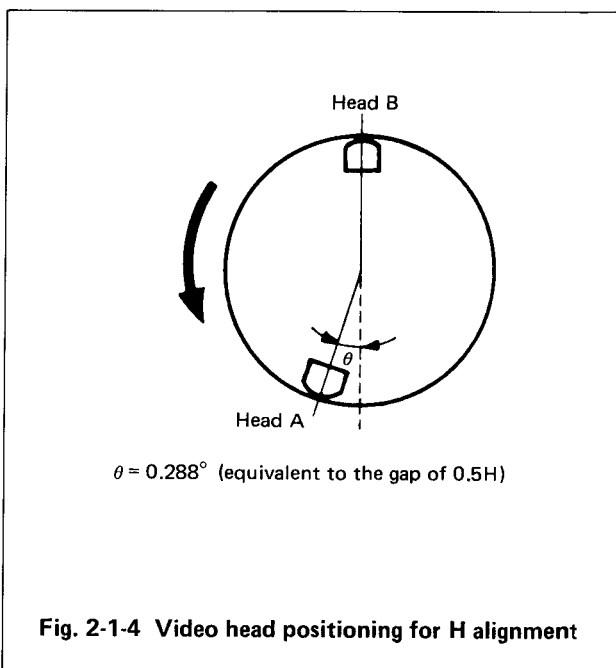


Fig. 2-1-4 Video head positioning for H alignment

e. Luminance comb filter

By passing the playback Y signal through the 1-H comb filter to prevent the mixing of the crosstalk from the adjacent track, the S/N ratio is improved.

2. Colour Recording System

The recording system for the PAL colour signal is a Y/C separation system and is similar to other systems in that the luminance signal is frequency modulated and the chrominance signal is frequency converted to the low frequency range, and then they are both AM recorded. (Refer to Fig. 2-1-5.)

The Y (luminance) signal is frequency modulated by the frequency modulator within a frequency range of 3.8 ~ 5.2 MHz. The C (chrominance) signal is low-frequency converted from 4.43 MHz to $(44 - 1/8)f_H$ on track A and $(44 + 1/8)f_H$ on track B; however, because the recording in this system does not have a guard band, there is a problem during playback from crosstalk disturbance from the recorded signal in the adjacent track. An explanation is given herein for why $(44 - 1/8)f_H$ and $(44 + 1/8)f_H$ were selected as the frequencies for low frequency conversion for track A and track B, respectively, and also for the method used for elimination of the previously mentioned crosstalk.

a. Low frequency range conversion chrominance signal frequencies

As an example, the playback of track A is as follows: It was previously mentioned that the chrominance frequency that is converted to the low frequency and recorded on track A is $(44 - 1/8)f_H$; however, this frequency can be expressed as $\cos(WcT + \phi)$, where

$$Wc = (44 - 1/8)f_H \times 2\pi$$

ϕ represents the phase shift at the early stage, and is not a function of time

$$\begin{aligned} \cos(WcT + \phi) &= \cos[2\pi(44 - 1/8)f_H \cdot t + \phi] \\ &= \cos(2\pi \cdot 44 \cdot f_H \cdot t - 2\pi \cdot 1/8 \cdot f_H \cdot t + \phi) \end{aligned}$$

In the above equation, assuming that t is the unit for the time period of one horizontal scan, the time function of the component, $2\pi \cdot 44 \cdot f_H \cdot t$, is not related to the phase shift. In addition, because ϕ is the constant which represents the phase at the early stage, it does not produce the phase shift as a function of time. The remaining component, $2\pi \cdot 1/8 \cdot f_H \cdot t$, is the part concerned with the phase shift as a function of time.

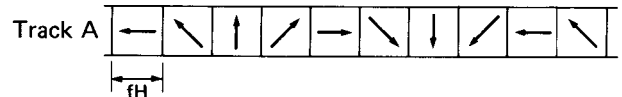
In order to simplify this equation, focus is centred only on the component $2\pi \cdot 1/8 \cdot f_H \cdot t$, which is related to the phase shift as a function of time.

When $t = \frac{1}{f_H}$ (looking at the phase shift of each horizontal scan period):

$$2\pi \cdot 1/8 \cdot f_H \cdot t = 2\pi \cdot 1/8 \cdot f_H \cdot \frac{1}{f_H} = \frac{2\pi}{8} = \frac{\pi}{4}$$

In other words, the phase shift of each horizontal scanning line of track A which is converted to the low frequency range and then recorded on the tape shifts $\frac{\pi}{4}$ each time.

This can be illustrated as:



As can be seen, the phase shifts clockwise $\frac{\pi}{4}$ at each horizontal scanning period.

The equation for the chrominance signal phase converted to the low frequency range and recorded on track B is:

$$\cos(WcT + \phi) = \cos[(44 + 1/8)f_H \cdot t + \phi]$$

The phase shifts anti-clockwise $\frac{\pi}{4}$ at each horizontal scanning period. Again, this can be illustrated as:

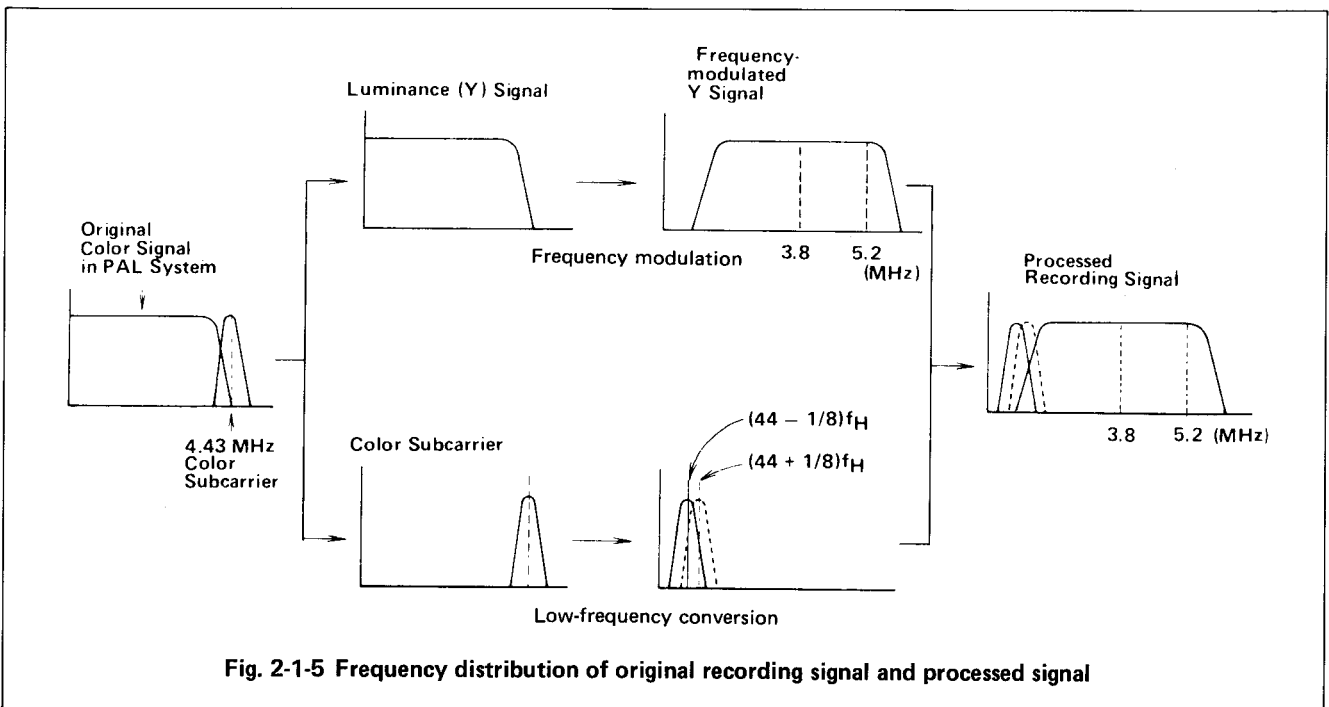
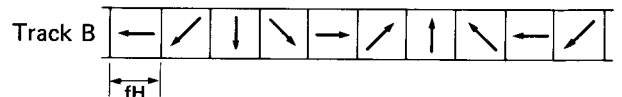


Fig. 2-1-5 Frequency distribution of original recording signal and processed signal

b. Elimination of the colour crosstalk component

Next, an explanation is given with regard to how the crosstalk from an adjacent track is eliminated based on the actual encoding on the magnetic tape.

Fig. 2-1-6 shows the correlation of the actual encoded chrominance signal phase. An explanation will now be given concerning how the crosstalk from the adjacent track A is eliminated during playback of track B. First, it can be observed in the illustration that the phase of the recorded chrominance signal for both track A and track B shifts only $\frac{\pi}{2}$ at every 2H (2 horizontal scanning periods). By making use of this, the crosstalk can be eliminated by passing it through a comb filter. An explanation will now be given concerning this phase shift at every 2H.

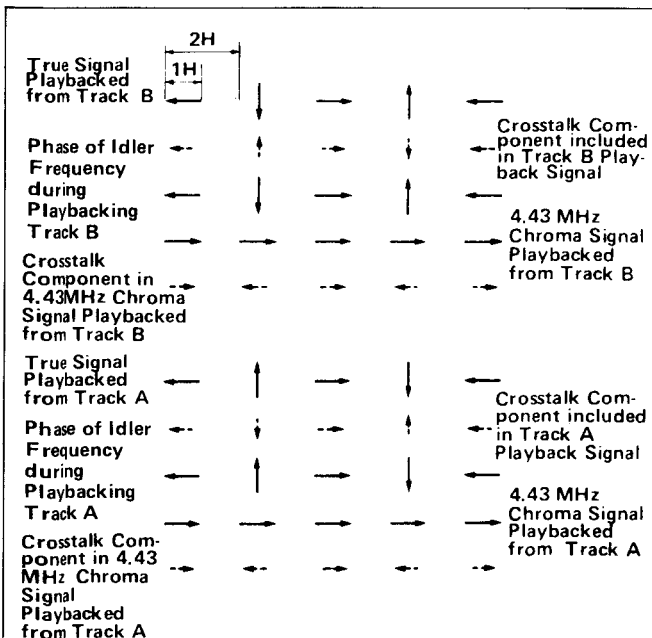
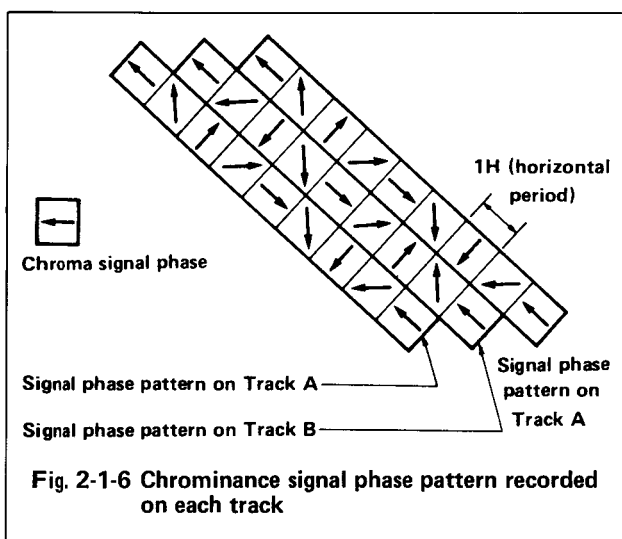


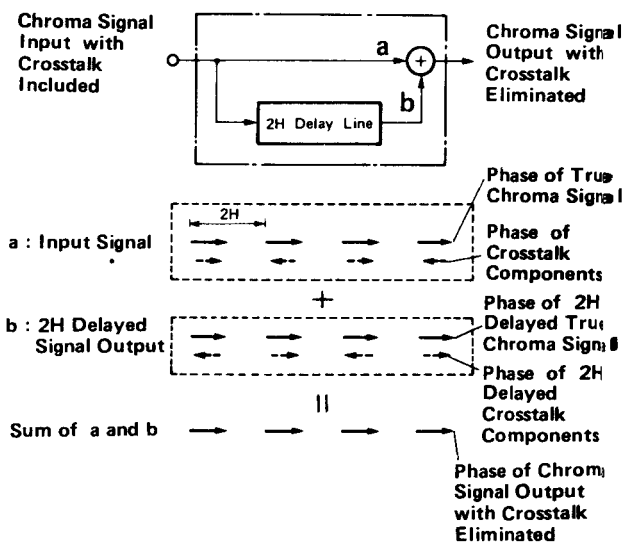
Fig. 2-1-7 is a simple illustration of the phase relationship between the playback chrominance signal and the crosstalk signal, and shows that the idler frequency of $4.43 \text{ MHz} + (44 \pm 1/8)f_H$ is for returning the low-frequency-converted chrominance signal being played back to the 4.43-MHz chrominance playback signal.

Fig. 2-1-8 shows the elimination of the crosstalk from the adjacent track by passing the signals through a comb filter. When the signal that passes through the 2H delay line is added to the signal that does not, the signal components can be added because they are in-phase; however, because the crosstalk components are phase inverted every 2H, they cancel each other and both are eliminated. In order to simplify the explanation it was omitted, but actually, because the phase of the colour subcarrier wave is inverted every 2H because of the 1/4 line offset of equation (2) (refer to section II-A-3. "PAL System Subcarrier Frequency"), the direction of the true signal and that of the crosstalk in Fig. 2-1-8 are reversed. It follows, therefore, that the crosstalk can be cancelled by subtracting b from a.

c. AFC and APC loops

To eliminate phase fluctuation of the chrominance signal due to jitter, etc., occurring in the recording and playback process, new APC (Automatic Phase Control) and AFC (Automatic Frequency Control) systems have been adopted.

In a conventional VCR, phase fluctuations are eliminated primarily by the APC circuit. The AFC circuit utilizes the playback horizontal synchronizing signal to detect large variations in the tape speed (such as during the "slow" and "still" modes), shifts the operating point of the APC circuit, and widens the APC locking range.



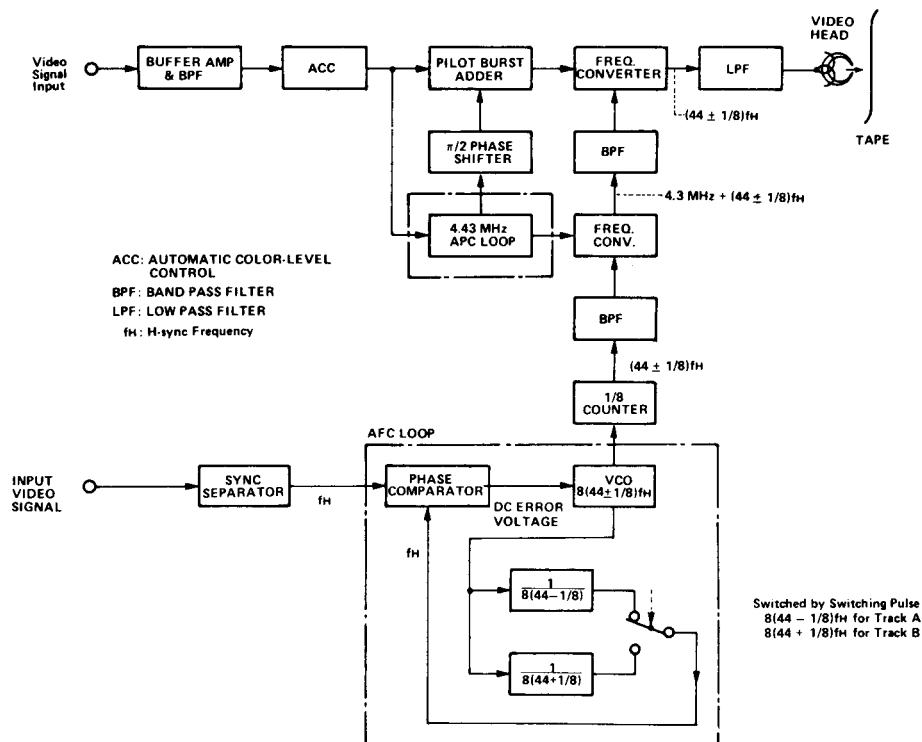


Fig. 2-1-9 Block diagram of the AFC and APC loops during the REC mode

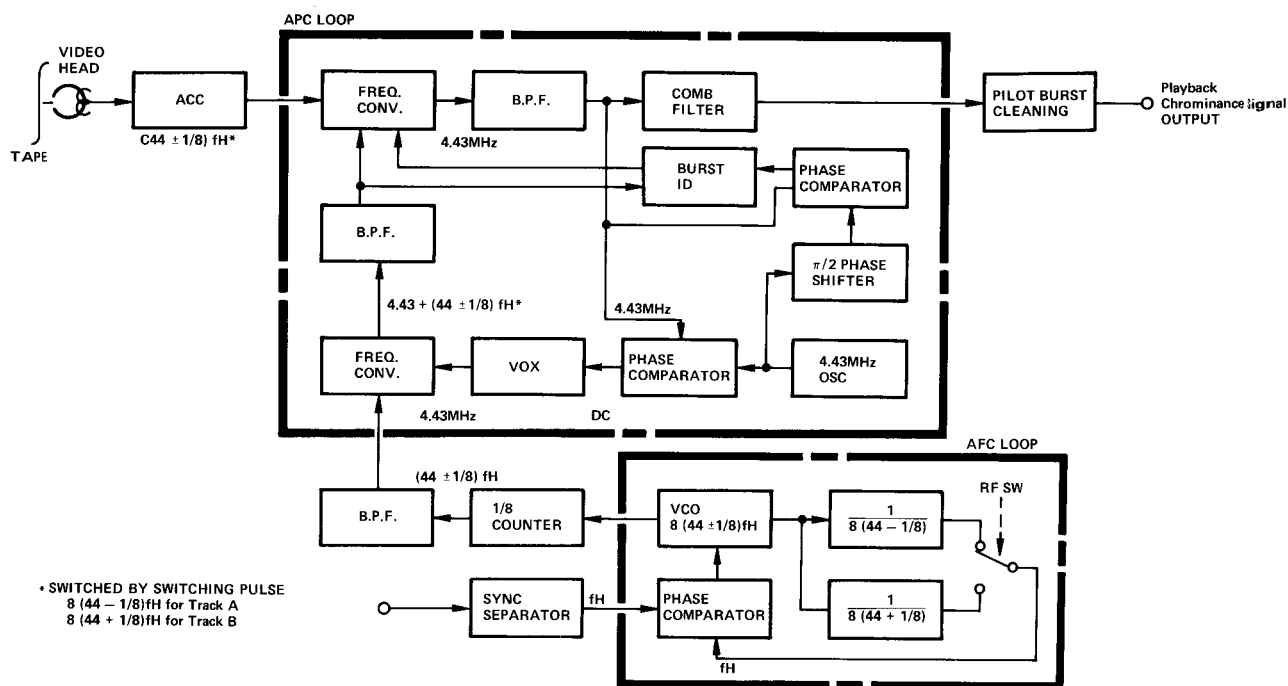


Fig. 2-1-10 Block diagram of the AFC and APC loops during the PLAY mode

As previously mentioned, the frequency of the chrominance signal converted to a low frequency range is changed to a frequency of $(44 \pm 1/8)f_H$, which is the frequency which is synchronized with the horizontal synchronizing signal frequency (f_H) of the video input signal.

The following is an explanation of the processing of the chrominance signal in the REC mode as shown in Fig. 2-1-9: The PAL chrominance burst signal phase swings alternately $+135^\circ$ and -135° each 1H. Because of this, it is difficult to use this burst signal to compose the APC loop during playback. Consequently, a 4.43-MHz continuous wave which undergoes automatic phase control (APC) is added to the input chrominance signal burst phase as a pilot burst, and this pilot burst is used to compose the APC loop during playback.

The chrominance signal frequencies converted to a low frequency range during recording are changed to $(44 - 1/8)f_H$ for track A and $(44 + 1/8)f_H$ for track B; however, this is obtained by the following process:

A signal 351 times (for track A) and one 353 times (for track B) the horizontal synchronizing signal is generated by an $8(44 \pm 1/8)f_H$ VCO (Voltage Controlled Oscillator), and then the sum frequency of the $1/8$ counted down $(44 \pm 1/8)f_H$ of the VCO and the 4.43-MHz crystal oscillator output (which is automatic phase controlled to the input chrominance signal) is used as the frequency conversion carrier (the idler frequency).

The VCO output is counted down $1/351$ for track A and $1/353$ for track B, and then the AFC loop compares the phase with the horizontal synchronizing signal, and uses the voltage difference to control the VCO.

[This type of circuit is essentially a PLL (Phase-Locked Loop); however, it is usually called AFC in the television industry and, therefore, will be called the AFC loop herein.]

The above mentioned frequency relationship is maintained, and the chrominance signal and the Y-FM signal are recorded on the tape.

When a signal which has been recorded this way is played back, the phase fluctuation of the horizontal synchronizing signal of the playback video signal can be thought to be essentially equivalent to the phase fluctuation of the playback $(44 \pm 1/8)f_H$ kHz chrominance signal divided by $(44 \pm 1/8)$.

During playback, just as during recording, a signal which results from multiplying the repeating frequency of the playback horizontal synchronizing signal by $(44 \pm 1/8)$ is generated by the AFC loop. The sum frequency (the idler frequency) and the crystal oscillator output (which is the 4.43 APC frequency) cancels out the phase fluctuation of the chrominance signal through the process of frequency conversion. (Refer to Fig. 2-1-10.)

During recording, the APC loop generates the 4.43-MHz continuous wave which is automatic phase controlled to the input chrominance signal burst phase, and this is recorded as the pilot burst. During playback, this pilot burst is detected, and serves as the reference signal to

compose the APC loop. The reason for locking the pilot burst phase is so that the automatic phase control of the chrominance signal can be done easily during still frame playback.

d. Pilot burst signal

Because the necessity of the pilot burst in the PAL BETACORD system was explained in section c, it will not be repeated; however, the position and level for the addition of the pilot burst is shown below.

The pilot burst signal for use in automatic phase control is added at the level of either 80% of the chrominance signal or approximately 1.6 times the colour burst signal.

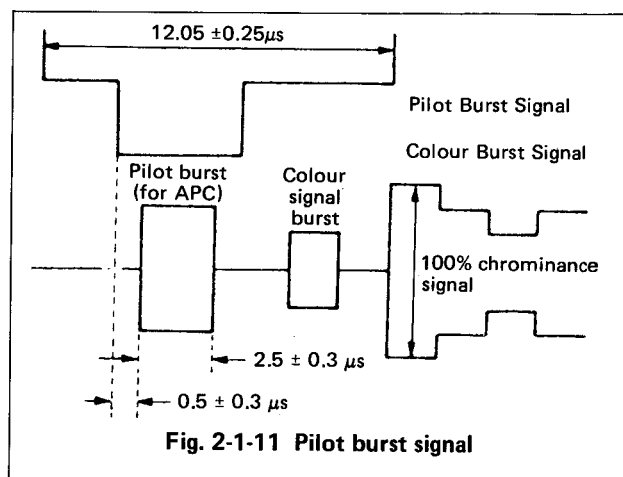


Fig. 2-1-11 Pilot burst signal

C. VIDEO CIRCUIT

1. Video System Circuitry

The video system circuit is composed of the VD-1 circuit board and the VD-2 circuit board. The portion of the video circuit on the VD-1 circuit board is composed of the RF recording/playback amplifier and the luminance signal (Y) recording/playback processing circuit.

The portion of the video circuit on the VD-2 circuit board is composed of the chrominance signal recording/playback processing circuit.

In addition, the video circuit is composed of the following ICs:

Luminance signal system: CX-134A, HA11701, HA11703, and LA7013
Chrominance signal system: CX-136A, CX-832, CX-150, MB14300, and TC4053

Frequency conversion system: CX-832 and MB14300

2. Video Signal Circuitry

a. Luminance signal processor circuit

The luminance signal (Y) circuit uses four ICs: CX-134A, HA11701, HA11703, and LA7013.

The function of each IC is listed below:

CX-134A (Q1501) comprises a pre-amplifier, a limiter, a dropout compensator circuit, and an RF switch.

HA11701 (Q1003) is the IC for recording of the luminance signal, and comprises a frequency modulator, an AGC amplifier, and a clamping circuit.

HA11703 (Q1001) is the IC for playback of the luminance signal, and comprises a frequency demodulator, a noise canceler, and a luminance/chrominance mixing

amplifier.

LA7013 (Q1004) comprises a luminance signal comb noise canceler, a frequency modulator, a limiter, and an adder circuit.

The block diagram for the luminance signal processor circuit is shown in Fig. 2-1-12.

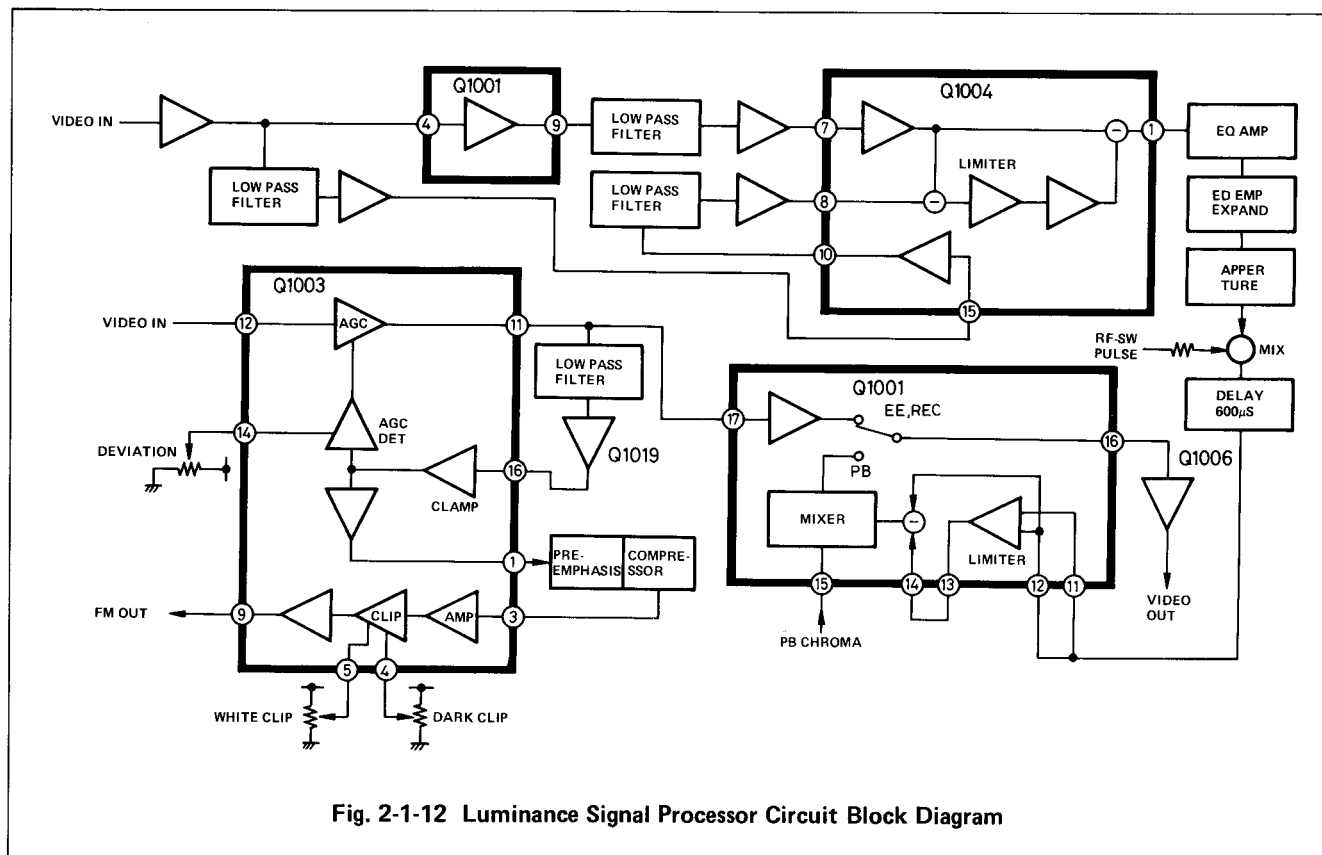


Fig. 2-1-12 Luminance Signal Processor Circuit Block Diagram

(1) AGC (Automatic Gain Control)

The amplitude of the luminance component of the video signal input is made constant by the AGC circuit of Q1003, and the DC level of the sync tip is clamped by the clamping circuit. This is done in order to fix the input level and operating point of the frequency modulator. There are two systems in the AGC; one is the sync AGC and the other is the peak AGC.

The synchronizing signal remains unchanged regardless of the contents of the broadcast; therefore, it is detected in order to be used to control the AGC amplifier. This system is called the sync AGC. The detection of the synchronizing signal is accomplished by raising the horizontal blanking level of the video signal and detecting its peak.

However, at times, the V/S ratio (normally 7:3) may change in instances where the white level exceeds 100%, the synchronizing level falls due to broadcasting conditions, etc. Because such an occurrence would result in overmodulation, the peak AGC circuit comes into operation when the white level exceeds 100%.

The video signal enters pin (12) of Q1003, passes through

the AGC amplifier, and is output from pin (11).

R1074 and C1052 compose the peak hold circuit for the sync AGC. The peak AGC operation is performed within Q1003.

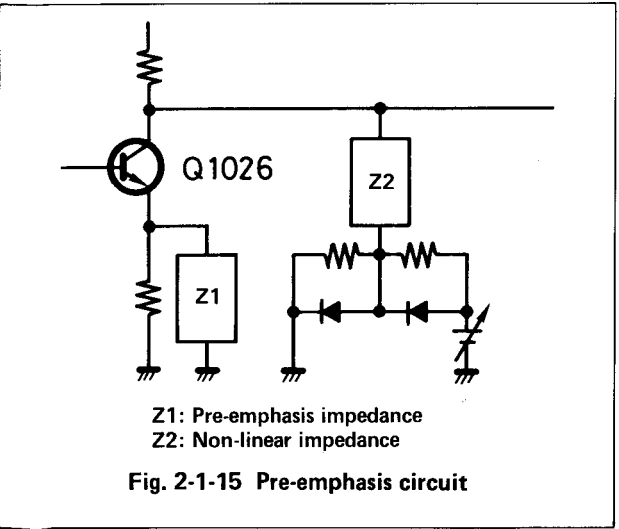
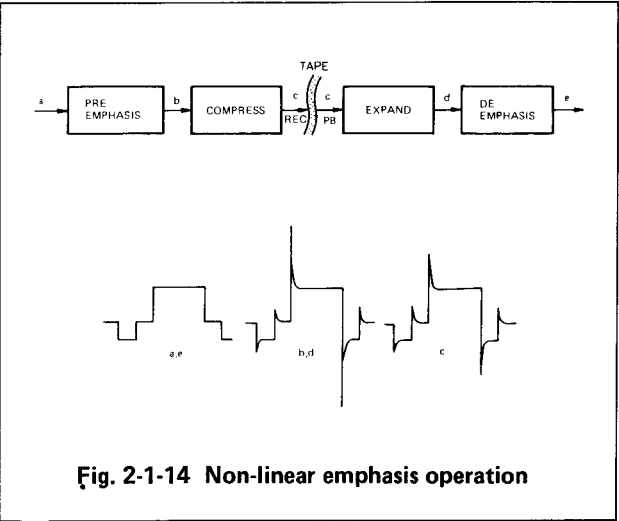
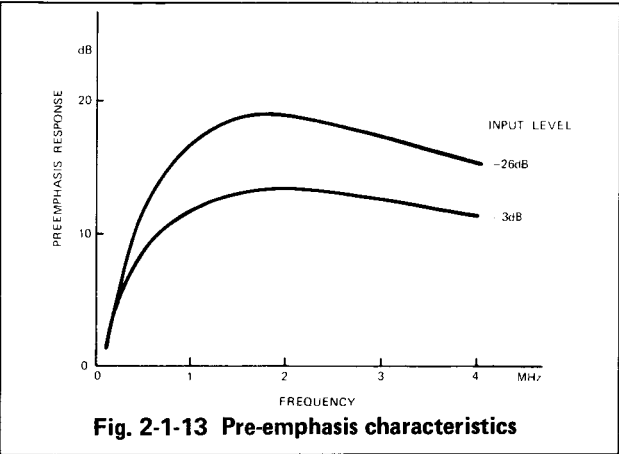
(2) Pre-emphasis

Generally, the higher the modulation frequency of an FM wave, the more likely it is to be affected by noise; therefore, by first amplifying the high frequency component within the input signal and increasing the degree of modulation, the noise effect can be reduced. In addition, the S/N ratio is improved by increasing the degree of modulation when the input amplitude is small and decreasing it when the input amplitude is great. (Refer to Fig. 2-1-13.)

This is called the "non-linear emphasis" or "compressor" circuit.

As shown in Fig. 2-1-14, in regard to the video signal waveform, this circuit suppresses the shooting of the large high-amplitude portion, then restores it during playback. The emitter side of Q1026 shown in Fig. 2-1-15 is the pre-emphasis constant, and the collector side is the

non-linear pre-emphasis circuit. Utilizing the non-linear characteristic of the diode, the suppression effect of becomes stronger as the amplitude increases. The signal passes through Q1025, Q1024, and Q1023, and the dark shooting and the white shooting are limited within Q1003, thus preventing over-modulation. This signal is next converted to an FM signal in the frequency modulator, and sent to the recording amplifier.



(3) Frequency modulator

The frequency modulator makes use of an astable multi-vibrator, which determines the frequency through the use of C1049, which is connected to pin (7) and pin (8) of Q1003. The oscillation frequency is determined by VR1007 and the duty cycle is determined by VR1006. By having the FM signal output from pin (9) of Q1003 pass through the H.P.F., it is possible to prevent interference with the colour subcarrier recording signal which is converted to a low frequency range during the colour mode.

(4) Recording amplifier

In the luminance recording amplifier Q1507 ~ Q1510 of the VD-1 pre-amplifier section, the luminance FM signal from the VD-1 video section is amplified to a voltage sufficient to drive the video head. The recording chrominance signal (688 kHz) from VD-2 is power amplified by Q1511, mixed with the luminance FM signal in the resistance mixing circuit (R1554 and R1555), and then both signals are sent to the video head.

(5) Playback amplifier and dropout compensator circuit (DOC)

Q1501 is composed of the playback pre-amplifier, the RF switcher, the limiter, and the dropout compensator circuit. After the output from the video head has been sufficiently amplified and the frequency response corrected, the luminance FM signal undergoes amplitude limitation in the limiter and is supplied to the demodulation circuit. The block diagram is shown in Fig. 2-1-16. The pre-amplifier and RF switcher have two channels corresponding to video head A and video head B, and, because both channels have the same structure, channel A will be used as an example herein.

The faint signal output from the video head passes through the rotary transformer and the step-up transformer (T1501), and is supplied to the FET amplifier Q1502. Q1502 is connected to the amplifier inside the IC, and this composes a cascode amplifier. The power supply to the pre-amplifier section is DC +6V, which has been stepped down from DC +12V by R1535. In addition, in order to stabilize the IC, the power supply is bled by R1539. The output of the cascode amplifier passes through the emitter follower, and is supplied to the equalizer amplifier. The equalizer circuit is composed of L1510, C1524, and VR1503, which are connected to pin (20). In this circuit, middle-frequency-range correction at approximately 4.5 MHz is carried out. Balance adjustment is done by VR1506 so that the pre-amplifier outputs of both channels become equal.

The output from the equalizer amplifier is supplied to the RF switching circuit. A 25-Hz switching pulse, created by the 25 PG pulses A and B, is applied from the servo system to pin (18).

On the channel A side, when pin (18) is OFF, pin (20)

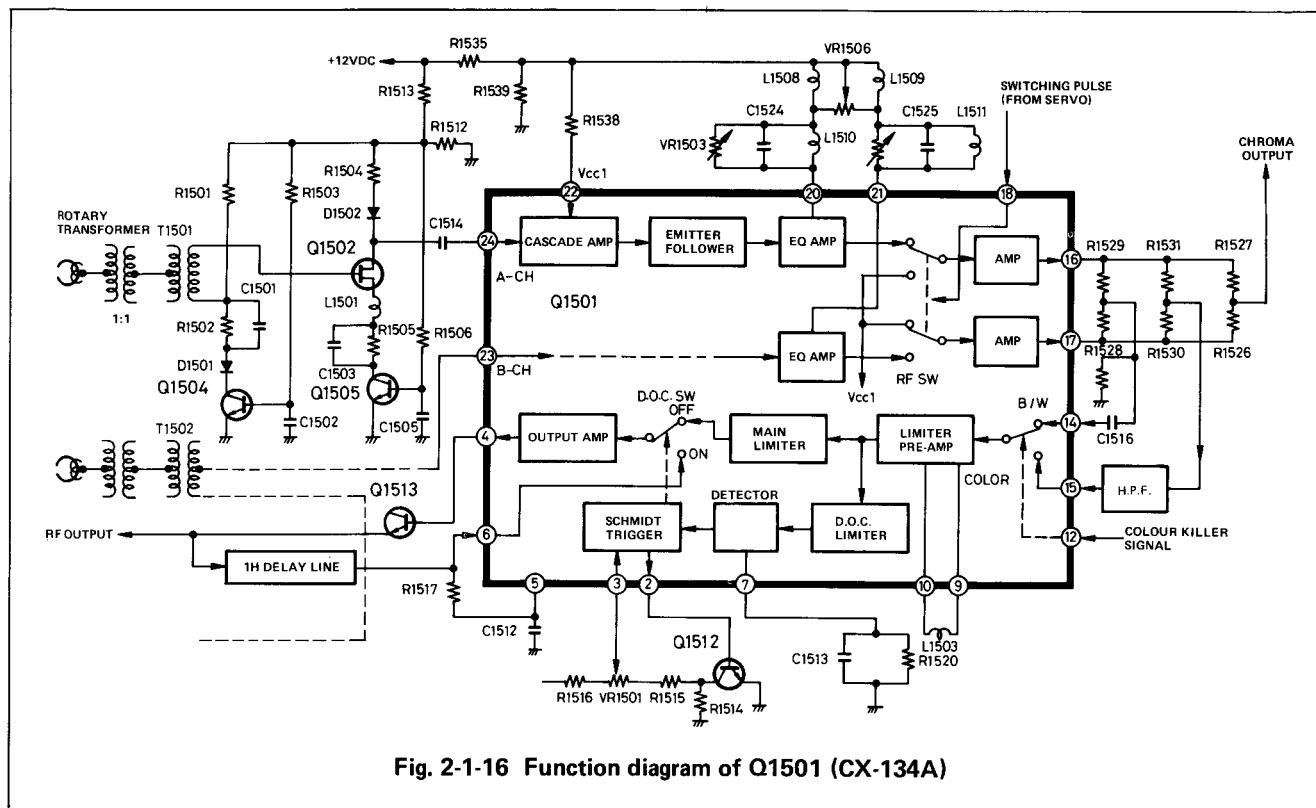


Fig. 2-1-16 Function diagram of Q1501 (CX-134A)

switches to the signal side, and when pin (18) becomes ON, pin (20) switches to the V_{CC1} power supply side. On the channel B side, the opposite occurs. Because of this, an RF signal from which the overlapping portion of both channels has been eliminated can be obtained. The output from the switching circuit passes through the amplifier and the emitter follower, and is output from pin (16) and pin (17).

The outputs of both channels from pin (16) and pin (17) are combined in the resistance mixing circuit, and become continuous output. The resistance mixing circuit is divided into three circuits:

- The RF signal which is mixed by R1526 and R1527 is supplied to the chrominance playback circuit on the VD-2 circuit board.
- The RF signal which is mixed by R1530 and R1531 passes through a high-pass filter (HPF), and is then supplied to the switching circuit of pin (15). In the high pass filter, the 688-kHz chrominance component of the playback RF signal is removed, and the luminance FM signal extracted.
- The RF signal which is mixed at R1528 and R1529 is supplied without change to pin (14), and becomes the switching circuit input for the black-and-white mode. For the colour/black-and-white switching circuit, pin (14) and pin (15) provide the signal input and pin (12) provides the switching voltage input.

A colour killer signal from Q1203 of the VD-2 circuit board is applied to pin (12). During the colour mode, a

voltage of approximately DC +4 V is applied to pin (12), and the input signal of pin (15) becomes the switching output. During the black-and-white mode, pin (12) becomes 0 V, and the input signal of pin (14) becomes the switching output. After this, the Y-FM signal is supplied to the limiter and to the dropout compensator circuit (DOC).

The Y-FM signal passes through the limiter pre-amplifier, and is applied to the main limiter and to the dropout compensator circuit. The purpose of the limiter pre-amplifier is to control waveform distortion caused by excessive input; it does not function as a limiter. In the main limiter, the amplitude of the Y-FM signal is limited by a limiter gain of approximately 25 dB, and amplitude fluctuation of the playback signal is eliminated. The output of the main limiter ordinarily passes through the DOC switch, and then through the output amplifier to be output from pin (4).

The output from pin (4) passes through the emitter follower Q1507, and is supplied to the de-modulation circuit of the VD-1 video section and the 1H delay line. The Y-FM signal applied to the 1H delay line is delayed by 1H and is supplied from pin (6) to the DOC switch. Prior to the detection in the stage, the DOC limiter acts at low strength on the signal to eliminate all but the dropout portion of the amplitude fluctuation component.

The output from the limiter passes to the detection stage, where the dropout is detected as a pulse. R1520 and C1513 of pin (7) form the smoothing circuit for the

detection output. The detection output is applied to a Schmitt trigger, and is formed into a switching pulse. The sensitivity of the Schmitt trigger is varied by VR1501, thus regulating the dropout compensation sensitivity. The output from the Schmitt trigger is applied to the DOC switch as a switch operation signal. Because of this, the DOC switch operates where the dropout component exists, and the pre-1H delay signal is added to the dropout component. Q1512, which is connected to pin (2), switches ON and OFF in accordance with the dropout detection pulse, and, by shorting and opening R1514, produces an ON/OFF hysteresis effect for the DOC.

(6) Y-FM demodulator circuit Q1001

The playback Y-FM signal supplied from Q1501 of the pre-amplifier portion of the VD-1 circuit board is applied to Q1001. Q1001 uses a frequency demodulator circuit of the type called a multi-vibrator, in which a multi-vibrator is used as a delay circuit. The system uses an FM signal to injection-lock the astable multi-vibrator, and makes use of the fact that the phase difference between the FM signal input and the multi-vibrator output is proportional to the FM frequency. In the injection-lock, the delay time (phase difference) of the multi-vibrator is constant with regard to the FM signal input, regardless of the frequency. Because the delay time is constant, the phase difference of the input signal increases as the frequency becomes higher. (Refer to Fig. 2-1-17.)

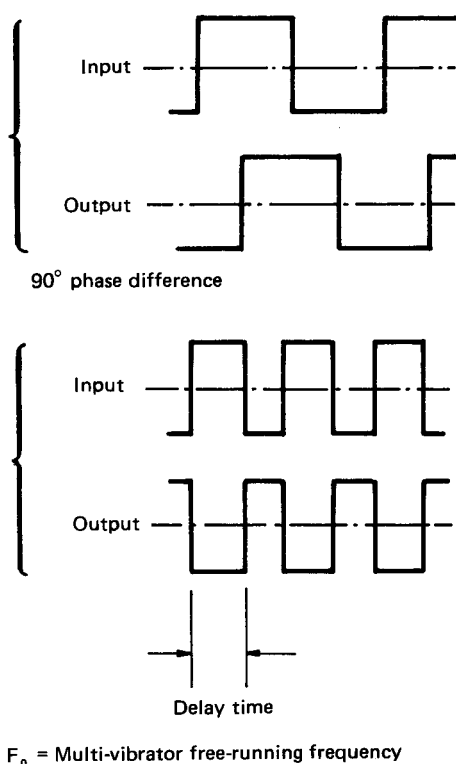


Fig. 2-1-17 Injection lock input and output signals

If the free-running frequency of the multi-vibrator is F_0 , then, when a signal of frequency F_0 is applied, the phase difference between the input and output will be 90° .

When a signal of frequency $2F_0$ is applied, the phase difference between the input and output will be 180° . The astable multi-vibrator is used as the frequency modulator during recording.

Because the input/output phase difference of the multi-vibrator is proportional to the input frequency, it is possible, through the use of a phase comparator (multiplier) to obtain a detected output proportional to the frequency.

This system is, in principle, a frequency modulator which is not affected by amplitude fluctuations of the FM signal; therefore, it is possible to greatly reduce the number of early section limiter stages.

(7) Y comb noise canceler circuit

If the signal and crosstalk spectrums are interleaved, this can be corrected by the use of a comb filter. During recording, an RF switching pulse (attenuated) is applied to the Y signal before modulation and the FM signal is interleaved between the tracks, and then during playback, this signal is passed through a 1H comb filter.

This theory of delay and addition is the same as that used in the colour signal comb filter. However, because the RF signal is frequency modulated and its spectrum is not interleaved, it is necessary that the addition operation be performed on the Y signal after de-modulation. The delay is of course carried out on the RF frequency. This comb filter works well only when the vertical correlation is large, in other words, only when two continuous scanning lines are the same signal. At any other time, because the signal is not interleaved, the comb filter also eliminates necessary information. In order to reduce this effect, the special circuit shown in Fig. 2-1-18 is used. Crosstalk Y_c is obtained by direct and delayed Y subtraction. This Y_c is passed through the limiter and subtracted from Y_{DIR} . Because the crosstalk signal is usually weak, it can be cancelled completely. Y_c signals above a certain threshold are considered necessary information and are not cancelled.

(8) Noise canceler circuit

This circuit extracts the high frequency component of the video signal, applies the signal to the limiter to extract the noise component, and then applies this noise component in reverse phase to the original signal in order to cancel the noise.

The playback Y signal is applied to pin (12) and pin (11) of Q1001, and then the high frequency component of this playback Y signal is extracted, passed through the limiter, and output from pin (13). The high frequency component passes through the high-pass filter and is input from pin (14), and then is applied in the reverse phase of the playback Y signal from pin (12), thus cancelling the noise.

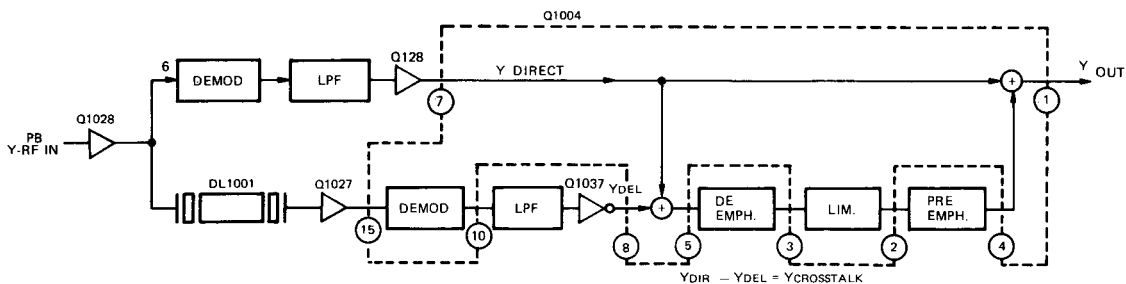


Fig. 2-1-18 Y comb filter block diagram

The noise canceler output is mixed with the chrominance signal from pin (15), passes through a switch, is output from pin (16), passes through the buffer Q1006, is input to pin (18), passes through the amplifier, is extracted from pin (20), and finally is supplied to the video output circuit.

(9) De-emphasis

The output of the Y comb filter, after undergoing phase compensation by the Q1034 low-pass filter, passes through the emitter follower of Q1033, thus causing the high-frequency component, which was emphasized by the pre-emphasis during recording, to be damped by the de-emphasis circuit of Q1017. (Refer to Fig. 2-1-20.) First, in the emitter side non-linear emphasis (expander) circuit, composed of Z₂, D1001, and D1002, the suppressed high amplitude portion shooting is restored, and then de-emphasis is applied by Z₁ of the collector side. The noise occurring in the chrominance range during the colour mode is blocked by the 4.43-MHz trap composed of L1007 and C1032. Q1014 and Q1015 compose the aperture circuit, and, using the delay time of L1006 and C1029, the contrast is sharpened.

The output of Q1015 is amplified by Q1013, Q1012, and Q1011; however, at this time, the RF switching pulse is added to cancel the 1/2H shift portion obtained during recording. The output of Q1011 is delayed by 0.6 micro-

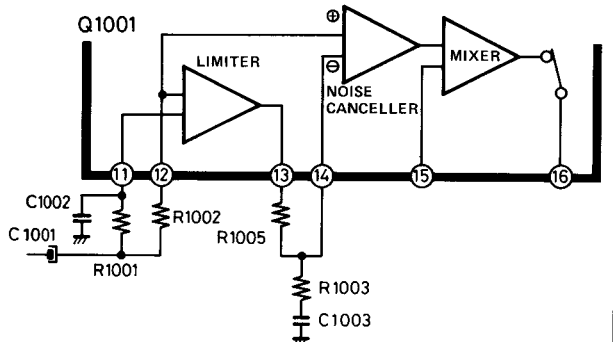


Fig. 2-1-19 Noise canceler circuit

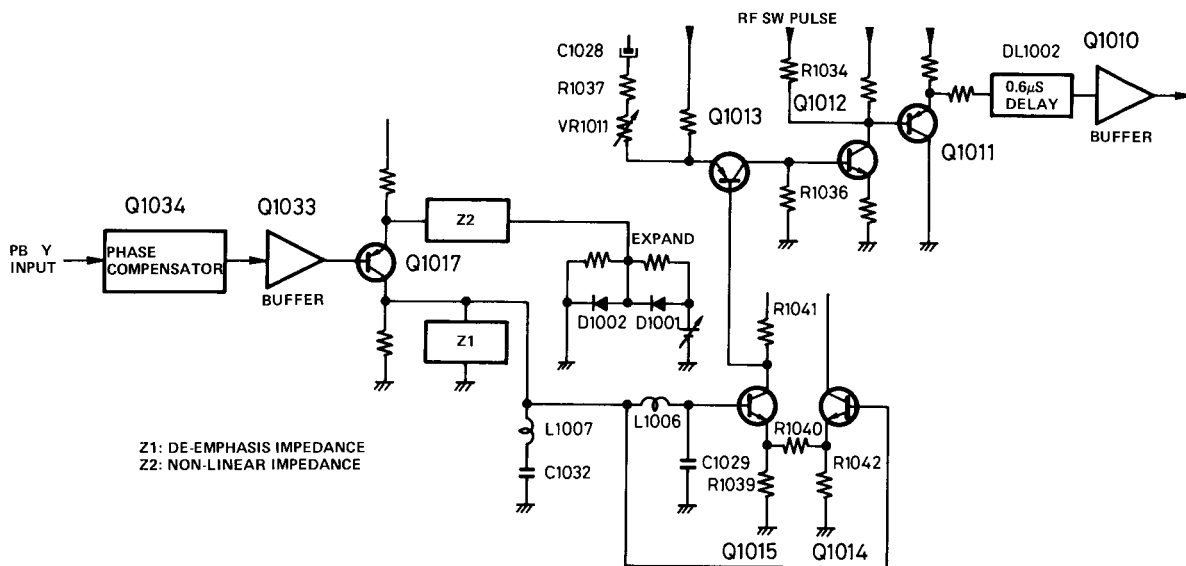


Fig. 2-1-20 De-emphasis circuit

seconds by DL1002 in order to achieve phase matching with the chrominance signal.

(10) Video output circuit

During the REC EE mode, the video signal which passes through the AGC circuit enters pin (17) of Q1001, passes through the switch within Q1001, and is extracted from pin (16).

During the PLAY mode, the playback chrominance signal processed by the chrominance system in the VD-2 circuit board enters pin (15) of Q1001, and a playback Y signal processed within the VD-1 circuit board enters pin (14) of Q1001. These two signals are mixed by the mixer, and, passing through the switch, are extracted from pin (16) of Q1001. The switch within Q1001 is controlled by the PB + 12 V input of pin (8). During the REC EE mode, the EE amp and pin (16) are connected, while during the PLAY mode, the colour mixer and pin (16) are connected.

The output from pin (16) of Q1001 passes through the buffer, enters pin (18), passes through the amplifier, is output from pin (20), and is then sent to the LINE OUT terminal through Q1008 and also to the RF converter through Q1007. Pin (19) of Q1001 uses the muting circuit input to cancel the picture during the PLAY mode in the event that there is no control signal. (Refer to Fig. 2-1-21.)

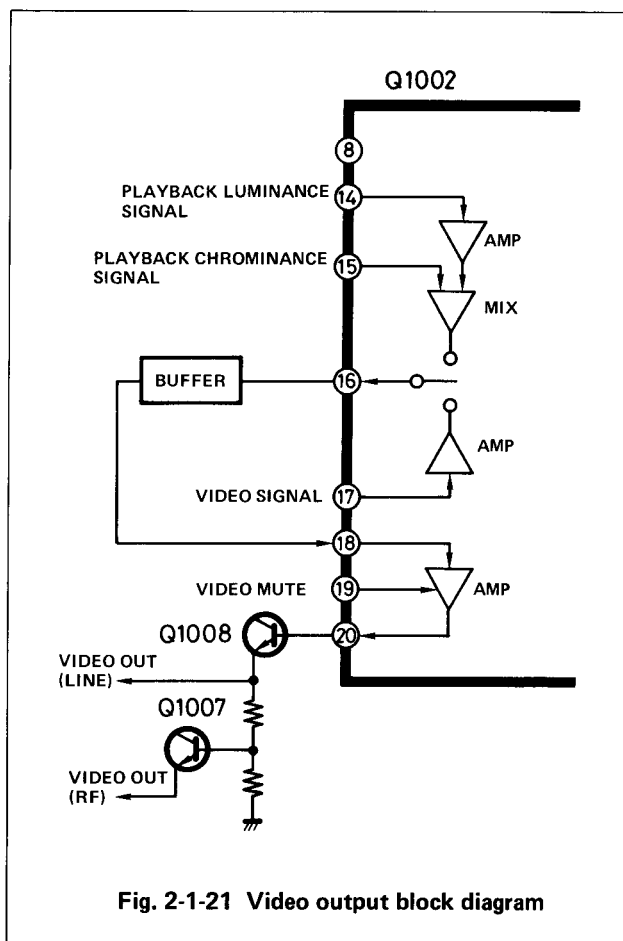


Fig. 2-1-21 Video output block diagram

b. Chrominance signal system circuitry (Refer to Fig. 2-1-22.)

Recording of the chrominance signal is done by the low frequency range conversion direct recording method. Because the recording pattern on the tape does not have a guard, the recording frequencies of the tracks are only $1/4 f_H$ apart, and during playback crosstalk from the adjacent track is eliminated by a comb filter. Therefore, the frequency of the chrominance signal which has been converted to a low frequency range is synchronized with the frequency of the horizontal-synchronizing signal of the video input signal.

The phases of the colour burst of the PAL signal vary by 90° each scanning line; therefore, when the APC is applied, the capture range is approximately half that of the NTSC system. Therefore, it requires many times as long for the APC to stabilize after head switching as it does for the NTSC system. To cope with this problem, a pilot burst (or quasi-burst) is added to the horizontal synchronizing period. This creates a stabilized system in which the APC converges rapidly. In order to preserve the continuity of the JOG mode, the pilot burst phase is locked to the input sub-carrier.

(1) REC mode

First, a pilot burst is added to the horizontal synchronizing period of the 4.43-MHz input chrominance signal. This utilizes a 4.43-MHz signal obtained from the APC loop and locked into the input chrominance signal. The chrominance signal to which the pilot burst has been added is applied to the frequency converter.

A carrier signal of 5.12 MHz $[4.43 \text{ MHz} + (44 \pm 1/8)f_H]$ is applied to the frequency converter, and here the chrominance signal is converted to a frequency of $(44 \pm 1/8)f_H \approx 688 \text{ kHz}$. The carrier signal is formed in the following manner:

During recording, a frequency of $(44 \pm 1/8)f_H$ is produced by the AFC loop from the horizontal synchronizing signal obtained by synchronizing separation of the video input signal (f_H = horizontal synchronous frequency). This is a PLL (Phase-Locked Loop) circuit. The output (approximately $8 \times 44 f_H$) of the voltage control oscillator (VCO) is counted down by $1/351$ for track A and $1/353$ for track B. It is then phase-compared with the horizontal synchronizing signal, and the oscillator is controlled by the voltage difference. In this way a signal of $8(44 \pm 1/8)f_H = (352 \pm 1)f_H$ which is synchronized with the horizontal synchronizing signal frequency of the video input signal is obtained.

Next, when this VCO output is $1/8$ frequency divided, the $(44 \pm 1/8)f_H$ signal is obtained. The output of the frequency divider is applied to the frequency conversion circuit. The 4.43-MHz output of the crystal oscillator is applied to the frequency conversion circuit; however, this frequency is locked to the chrominance signal in the following manner.

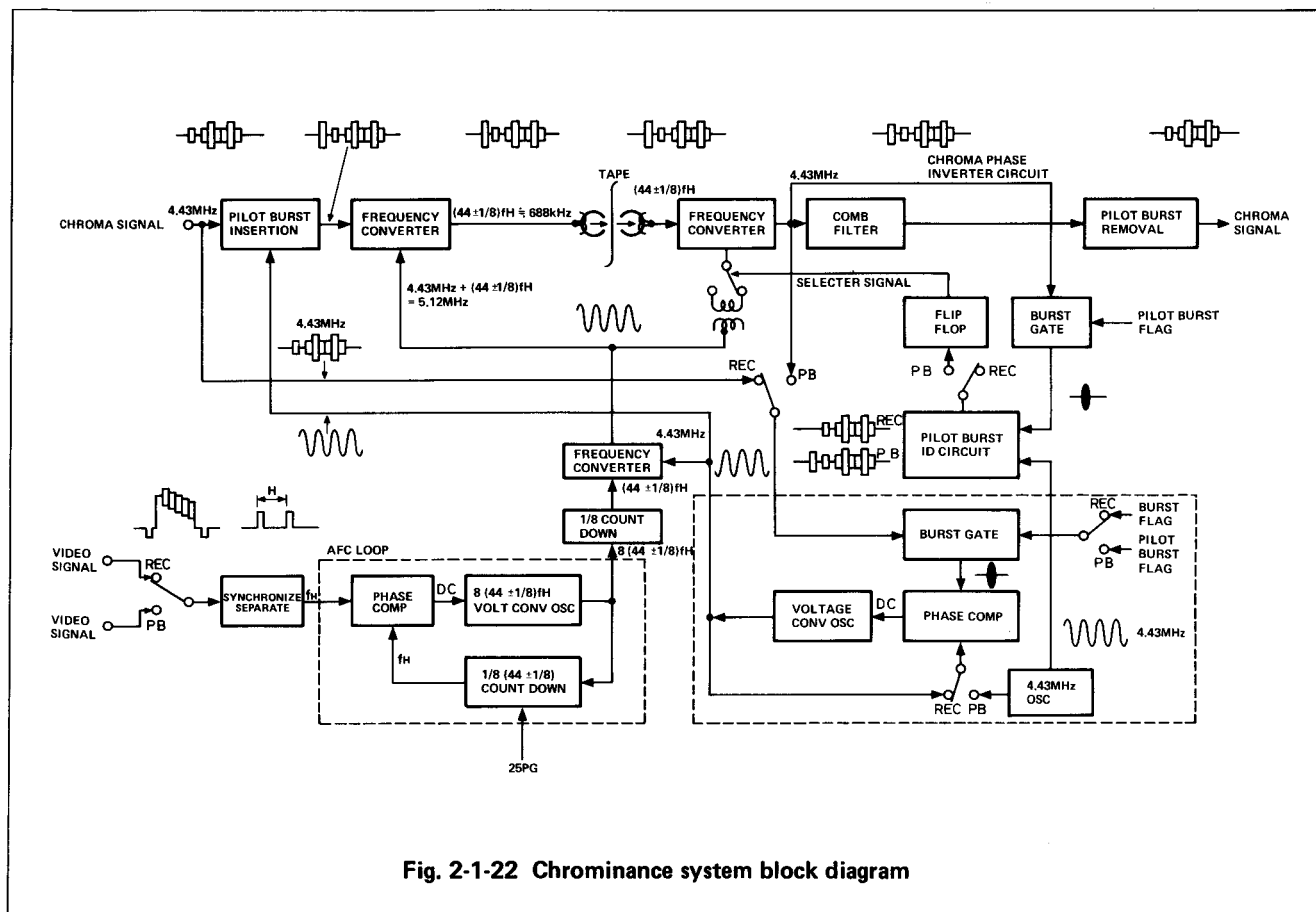


Fig. 2-1-22 Chrominance system block diagram

The output of the 4.43-MHz voltage controlled crystal oscillator (VXO) and the phase of the burst extracted from the input chrominance signal are compared, and the phase difference is converted to a direct current (DC) to control the VXO. An output of 4.43 MHz + $(44 \pm 1/8)f_H$ = 5.12 MHz is obtained in the frequency converter output. This 5.12-MHz output is supplied to the chrominance frequency converter for both the recording and playback sides.

As a result, the frequency of the chrominance signal which is converted to 688 kHz becomes $(44 \pm 1/8)f_H$ and synchronized in relation to the horizontal synchronizing signal frequency which is recorded. (+1/8 is for track B and -1/8 is for track A.) In this way, the chrominance signal which is converted to 688 kHz is recorded onto the tape together with the FM signal.

(2) PLAY mode

The 688-kHz chrominance signal separated from the playback output of the video head is frequency converted to 4.43 MHz by the frequency converter. A 5.12-MHz carrier signal is applied to the frequency converter from the same circuit that is used during recording.

During the PLAY mode, the input signal of the AFC loop becomes the horizontal synchronizing signal separated from the playback video signal. In addition, the input signal of the APC loop during the PLAY mode becomes

the pilot burst separated from the chrominance signal. However, during recording, the chrominance signal is recorded at the frequency of $(44 \pm 1/8)f_H$ which is synchronized with the horizontal synchronizing signal (f_H). In this way, when a recorded signal is played back, the relationship of the phase fluctuation (Δf_H) of the horizontal synchronizing signal of the playback video signal to the phase fluctuation (Δf_L) of the playback chrominance signal becomes $\Delta f_L = (44 \pm 1/8)\Delta f_H$.

The $(44 \pm 1/8)f_H$ output synchronized with the playback horizontal synchronizing signal is obtained in the AFC loop, and includes the $(44 \pm 1/8)\Delta f_H$ phase fluctuation. This signal becomes the carrier signal which frequency converts the playback chrominance signal to 4.43 MHz. This can be expressed as: 4.43 MHz + $(44 \pm 1/8)(f_H + \Delta f_H)$. Because the playback chrominance signal is $f_L + \Delta f_L = (44 \pm 1/8)\Delta f_H + (44 \pm 1/8)f_H$, the difference between this and the previous equation causes the phase fluctuation component to be canceled in the frequency converter, and the result is a phase-stabilized 4.43-MHz chrominance signal.

The phase fluctuation of the chrominance signal is almost completely eliminated by the AFC loop alone. In other words, the horizontal synchronizing signal is utilized as a pilot signal. However, because the frequency ratio of the pilot frequency f_H to the 4.43-MHz chrominance frequency is large, the residual phase error is magnified

by this same proportion, and the phase error in the 4.43-MHz signal cannot be ignored. For this reason the APC has been added.

The phase of the pilot burst signal within the chrominance signal which was converted to 4.43 MHz and that of the reference 4.43-MHz crystal oscillator output are compared, and the 4.43-MHz variable-frequency crystal oscillator is controlled by this voltage difference. In this way, the phase of the playback chrominance signal is stabilized.

In addition, because the playback chrominance signal is played back at the frequency of $(44 - 1/8)f_H$ for the field A period and at the frequency of $(44 + 1/8)f_H$ for the field B period, it is necessary to return this to the original continuous phase. This is performed by switching the frequency of the frequency conversion carrier signal to 4.43 MHz + $(44 - 1/8)f_H$ for the field A period and 4.43 MHz + $(44 + 1/8)f_H$ for the field B period, the same as for during recording.

Even in the APC system, which utilizes a pilot burst, a phase shift of as much as 180° may occur at the track switching point, due to the movement of the 25 PG pulse which detects the drum rotation during recording, or due to dropout or tape skew.

This results in the hue of the upper part of the picture becoming blurred because the APC circuit of the television set does not respond quickly enough. This is prevented by the pilot burst ID circuit shown in the illustration. Here the phase comparison of the 4.43-MHz crystal oscillator output and the pilot burst signal is done. When the phase of the pilot burst is approximately 180° at the changeover point, this is detected, a trigger pulse is supplied to the flip-flop (FF), the phase switcher is switched, and the phase is returned to approximately 0° .

After the pilot burst has been used in the APC, it is eliminated. In addition, the crosstalk in the playback chrominance signal from the adjacent track is eliminated by a comb filter.

c. Detailed parts description

The chrominance signal processor circuits are on the VD-2 circuit board and are composed of 5 ICs: CX-136A (Q1203), CX-832 (Q1201), CX-150 (Q1204), MB14300 (Q1205), and TC4053 (Q1202).

(1) Recording system chrominance signal processor Q1203 (CX-136A)

Q1203 is the chrominance signal processor IC for both recording and playback, and performs ACC (Automatic Chromalevel Control), frequency conversion, colour killer, etc. The block diagram and peripheral circuitry of Q1203 are shown in Fig. 2-1-23.

The video input signal is applied to the 4.43-MHz frequency range filter where the chrominance signal is separated. The filter output passes through the analog

switch (Q1218 and D1204) and is applied to the ACC gain control amplifier from pin (15) of Q1203. The levels for the ACC control range are +10 dB $\sim$ -16 dB (0 dB = 100 mVp-p).

The DC voltage which detects the burst signal in the later stage is applied to the gain control amplifier, and the gain control is performed so that the burst signal level becomes constant. The capacitor of pin (16) is a de-coupling capacitor. The ACC output of pin (12) passes through the pilot burst addition circuit of Q1202 (TC4053) and also through Q1212, and is supplied to the burst gate circuit.

The explanation will begin with the ACC loop: The chrominance signal which passes through the analog switch (Q1212 and D1202) passes through the comb filter which is composed of Q1210, DL1201, Q1209, and Q1208, and is then supplied to the output amplifier of pin (6) of Q1203. The output of the output amplifier enters the burst gate.

The burst is extracted in the burst gate by the burst gate signal which is applied to pin (22). The extracted burst signal is applied from pin (20) to the burst resonance transformer T1203. T1203 functions as a 4.43-MHz narrow frequency range filter, and eliminates all noise other than the burst.

Because the output of the T1203 resonance circuit is too large at this time, it is attenuated by the divider circuit of C1245 and C1246. The attenuated burst signal is supplied to pin (18). The burst signal of pin (18) is amplified by the filter amplifier to a level sufficient enough to drive the detector circuit. The 4.43-MHz burst signal is detected by the detector circuit and the detector output is supplied from pin (19) to the holding circuit which is composed of C1237 and R1246.

Switches 1 and 2 are always switched to the pin (19) side and the pin (10) side, respectively, because control terminal (7) is earthed. In order to hold the burst voltage which appears intermittently, the time constant of C1237 and R1246 is made sufficiently long. The DC voltage held in C1237 and C1238 is superimposed with another burst by T1203. This is detected by Q1222, and then kept smooth by the second time constant of C1248 and R1254. The loop is further stabilized by R1255, C1214, R1220, and C1249, and the signal is supplied to pin (10) and pin (11).

The voltage of pin (10) and pin (11) is amplified by the DC amplifier to control the ACC gain amplifier, and is also supplied to the colour killer circuit. The colour killer functions when the ACC loop is locked out. In order to increase the ACC amplifier gain when the chrominance input is small, the operating DC voltage of pin (10) and pin (11) decreases. If the input becomes smaller than the ACC coverage range, the ACC becomes locked out, and the voltage of pin (10) and pin (11) changes to about 1 V. When the voltage to pin (10) and pin (11) falls below 4 V, the colour killer begins functioning.

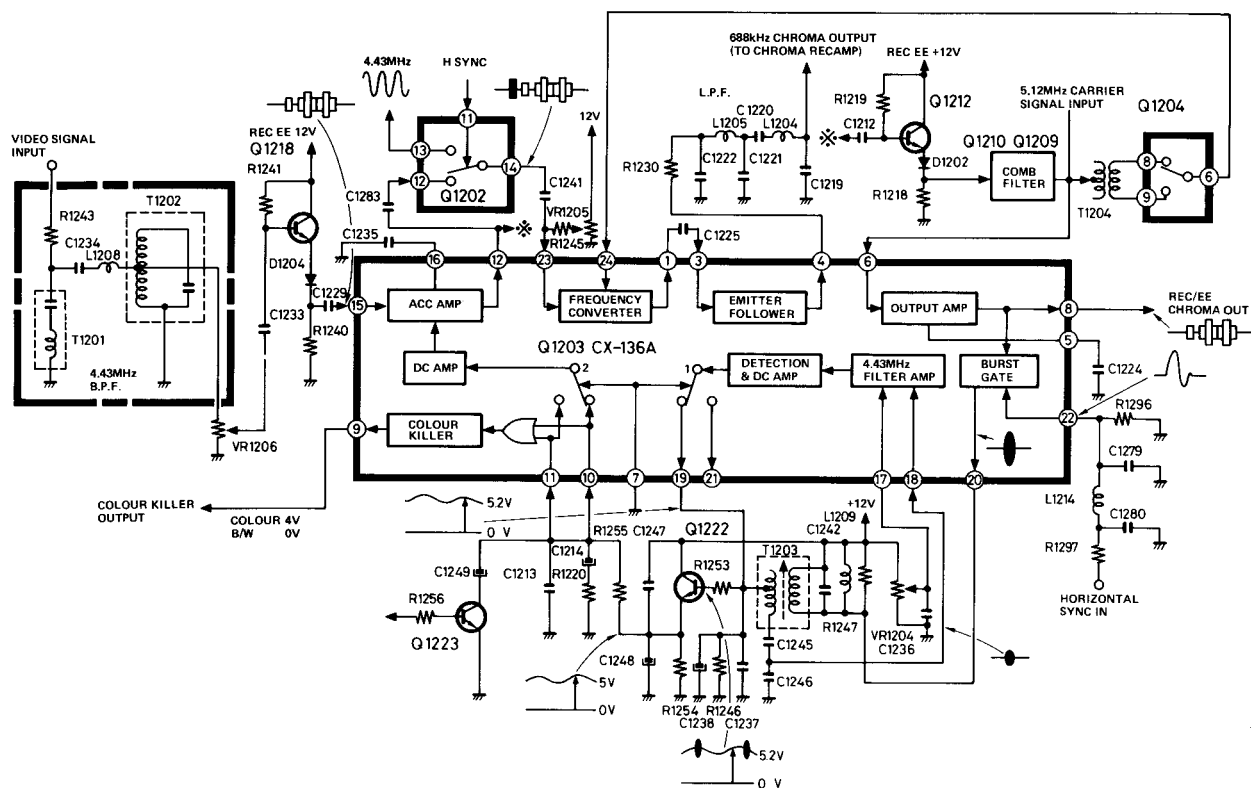


Fig. 2-1-23 Recording chrominance signal processor circuit Q1203 (CX-136A)

The colour killer level during playback is automatically determined by the setting of the VR1204 ACC output level. During recording, the record/playback balance is obtained by the setting of the VR1206 REC ACK level. Also, in order to increase the stability in the area of the colour killer functioning point, a hysteresis characteristic is provided.

The killer function is carried out during the black-and-white mode through the stopping of the function of the chrominance recording amplifier Q1214 by the output of the colour killer. The colour killer output of pin (9) is also used to stop the chrominance input to the Y/C mixer, and for the selection of the colour mode or black-and-white mode of the Y signal system.

Returning to the flow of the recording chrominance signal, after the pilot burst has been added by Q1202, the chrominance signal applied from pin (23) of Q1203 to the frequency converter is converted from 4.43 MHz to 688 kHz.

The frequency converter is composed of a balanced modulator. When the two inputs, f_s (4.43 MHz) and f_c (5.12 MHz) are applied to the balanced modulator, only the sum component of the two frequencies (approximately 9.55 MHz) and the difference component of the two frequencies (688 kHz) are obtained in the output.

Accordingly, if this difference component is separated by a filter, the 4.43 MHz chrominance signal is converted to a low frequency range ($f_c - f_s$), 688 kHz. The 5.12-MHz carrier signal passes through the burst ID circuit from Q1201, and is supplied to pin (24).

In this frequency conversion process, the frequency of the chrominance signal is converted to $(44 - 1/8)f_H$ for the field A period and $(44 + 1/8)f_H$ for the field B period. This frequency conversion is done by converting over the frequency of the AFC system.

The frequency converter output enters pin (3) from pin (1), passes through the emitter follower, and is supplied from pin (4) to the low band pass which is composed of L1205, L1204, and C1219 ~ C1222, where the 688-kHz component is separated. After the 688-kHz chrominance signal is amplified by the chrominance amplifier of Q1214, it passes through the Q1213 buffer, and is supplied to the recording amplifier of the VD-1 circuit board.

(2) Playback system chrominance signal processor Q1203

During the PLAY mode, the playback RF signal is supplied by the RF playback amplifier Q1501 located on the VD-1 circuit board. Because the Y-FM signal is contained in this playback RF signal, it passes through a low-pass filter where the FM signal is eliminated and the 688-kHz chrominance signal is extracted.

This filter output passes through the analog switch (Q1217 and D1203), and is applied to pin (15) of Q1203. This IC is the same as that used during recording. Fig. 2-1-24 shows the playback block diagram and the peripheral circuitry.

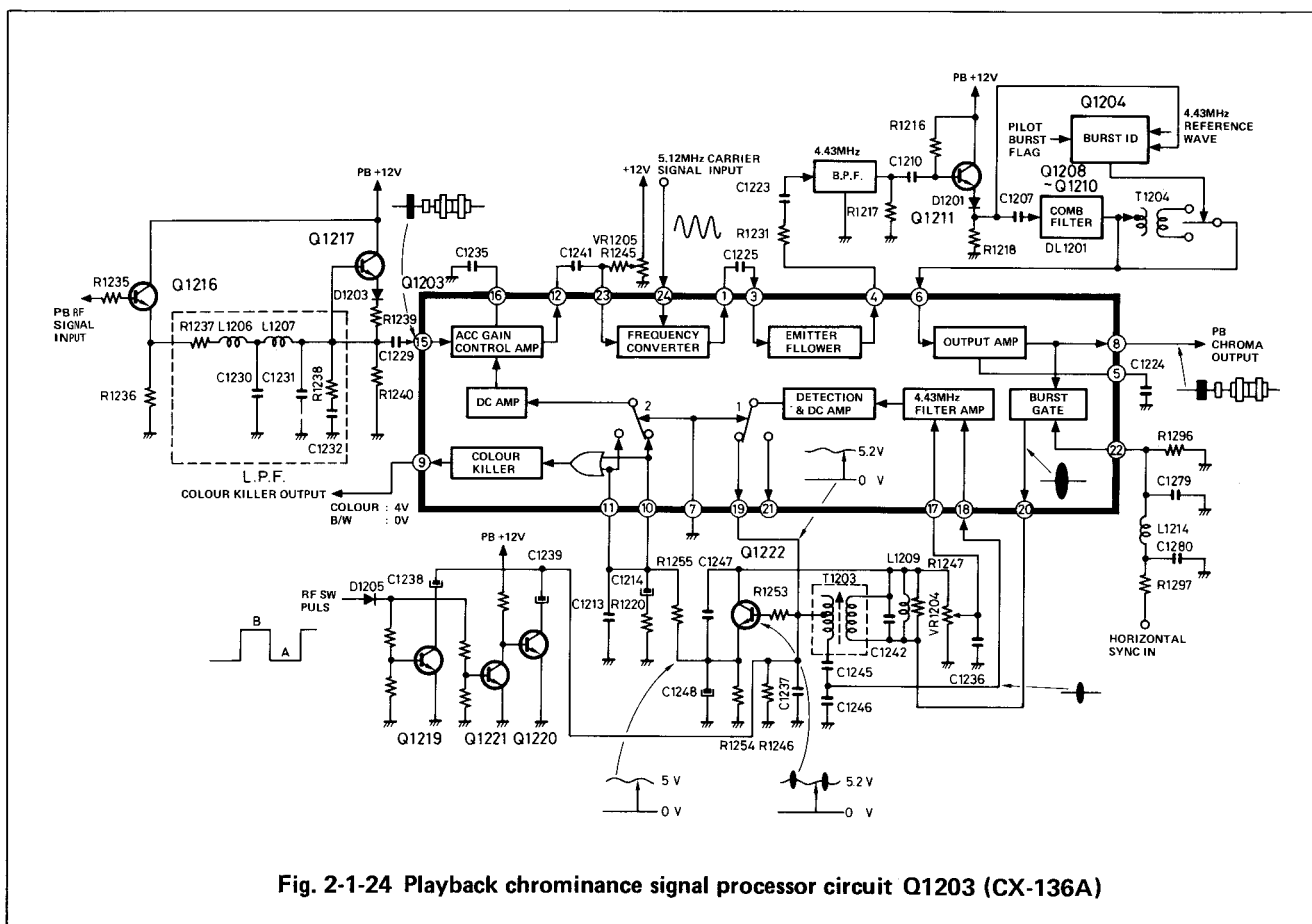
The 688-kHz chrominance signal is applied to the ACC gain control amplifier from pin (15). The DC voltage which detects the burst signal in the later stage is applied to the gain control amplifier, and gain control is performed so that the burst signal level becomes constant. There is an ACC detection output hold circuit for each channel; therefore, the ACC loop is set up in such a way that even when the level difference between the two channels A and B is great, the difference in the output level is reduced almost to zero.

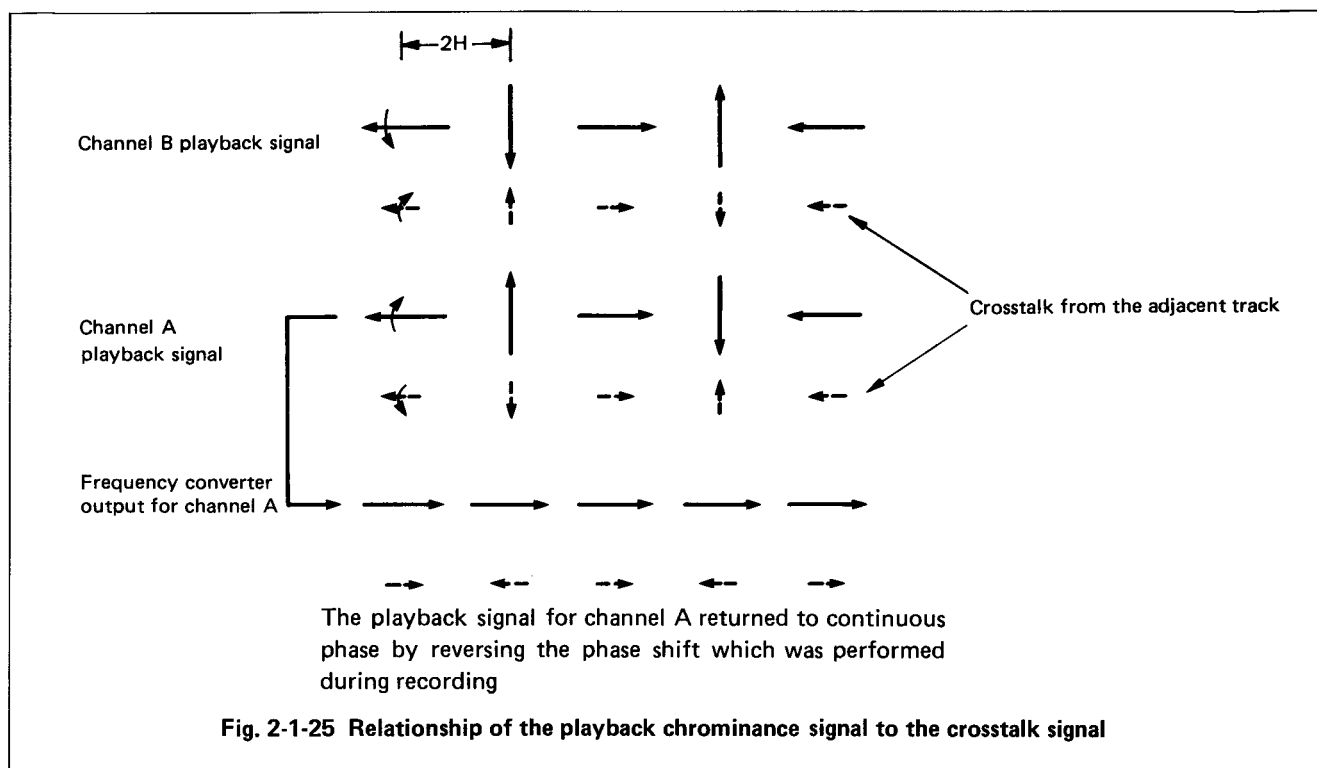
In addition, because a frequency converter, a comb filter, and an output amplifier are also included within the ACC loop, these deviations do not appear in the output.

The ACC output is applied to the frequency converter, and is converted to a frequency of 4.43 MHz, which is the difference between it and the carrier signal of 5.12 MHz. In frequency conversion during playback, the output frequency and carrier frequency approach one another in value; therefore, if the converter balance is poor, carrier leak will occur. In order to prevent this, balance regulation is carried out by VR1205.

In addition, the playback chrominance signal is $(44 - 1/8)f_H$ for channel A and $(44 + 1/8)f_H$ for channel B, but in this frequency conversion process, the signal is returned to a single frequency and continuous phase. This is accomplished by switching the AFC output frequency by either $(44 - 1/8)f_H$ or $(44 + 1/8)f_H$.

Because the frequency converter creates a difference, the directions of the phase shift of the carrier frequency and of the frequency converter output are always opposite; therefore, the direction of the phase shift of the chrominance signal is automatically reversed for the REC mode and the PLAY mode. Therefore, in the recording/playback process, the chrominance phase shift direction is reversed, and then reversed again, returning the vector to its original direction. (Refer to Fig. 2-1-25.) As a result, the phase of the crosstalk component from the adjacent track (for both A and B channels) is reversed every 2H.





The chrominance signal separated by the 4.43-MHz filter passes through the analog switch (Q1211 and D1201), and is applied to the comb filter. This comb filter is composed of a 2H delay line and a resistance mixer circuit. Here the crosstalk is eliminated by making use of the fact that, while the signal component is in continuous phase, the phase of the crosstalk component from the adjacent track shifts 180° every 2H.

In order to simplify the explanation up until now, the chrominance signal has been supposed to in-phase at every 2H and, in relation to this, the phase of the crosstalk component from the adjacent track has been assumed to reverse every 2H.

However, in actuality, because of the 1/4-line offset effect of the PAL system, the phase of the chrominance signal reverses every 2H, and, contrary to what has been said previously, the phase of the chrominance signal reverses every 2H and the crosstalk component remains in-phase.

In the comb filter, the 2H delay line output is subtracted from the signal which does not pass through the delay line.

As shown in Fig. 2-1-26, this is accomplished by having the two signals flow through R1209 in opposite directions. Because the crosstalk element is in-phase, it is cancelled by this subtraction, and the resulting output is zero.

In contrast, the result for the chrominance signal, whose phase shifts every 1H, is that it is added here to produce a doubled output. The chrominance signal obtained from the two ends of R1209 is amplified in the chrominance

amplifier Q1209, passes through the buffer Q1208, and is supplied to pin (6) of Q1203.

The burst gate uses the burst gate signal applied to pin (22) to extract the burst. From there until the point where the burst controls the ACC gain amplifier, the operation is the same as that during recording, with the following two exceptions: First, there are separate hold capacitors for channel A and channel B, and the switching between them is carried out by Q1219 ~ Q1221.

For this reason, there is an independent ACC loop for each channel, and this means that, even if the channel balance is poor and there is a large difference in the chrominance level of the two channels, there is hardly any difference in the ACC output.

An RF switching pulse passes through D1205 and enters Q1219; for channel B, Q1219 switches ON and C1238 is connected, and, in the same way for channel A, C1239 is connected. Next, C1249, which was connected to pin (10) and pin (11) during recording, is disconnected when Q1223 switches OFF. Because of head contact irregularities, etc., the playback chrominance signal contains, even within the field period, short-cycle fluctuations. Also, during playback variations, the level falls remarkably in the areas of the noise bands. Following this, in order to fix the amplitude, the burst is again superimposed by T1203 on the hold voltage of pin (19), and the peak is detected by Q1222. Accordingly, the time constant for points after Q1222 is, during playback, made shorter by Q1223.

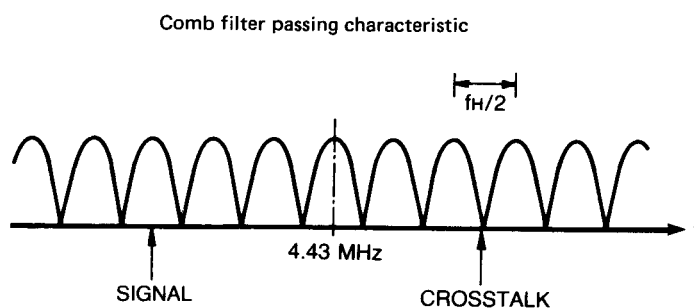
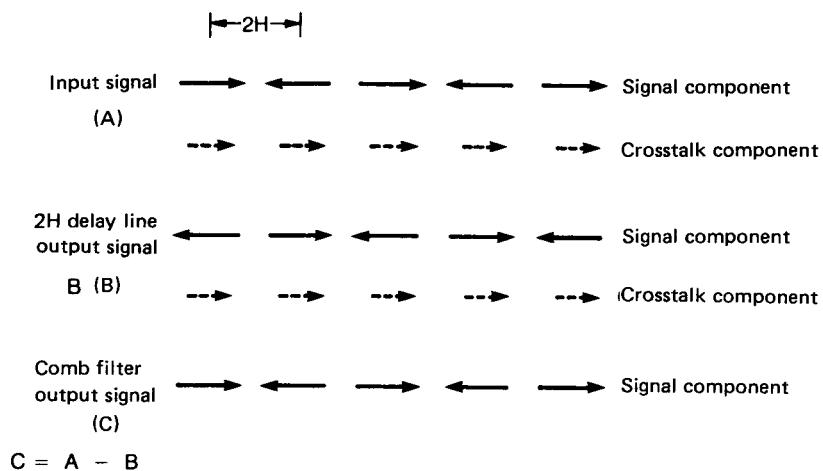
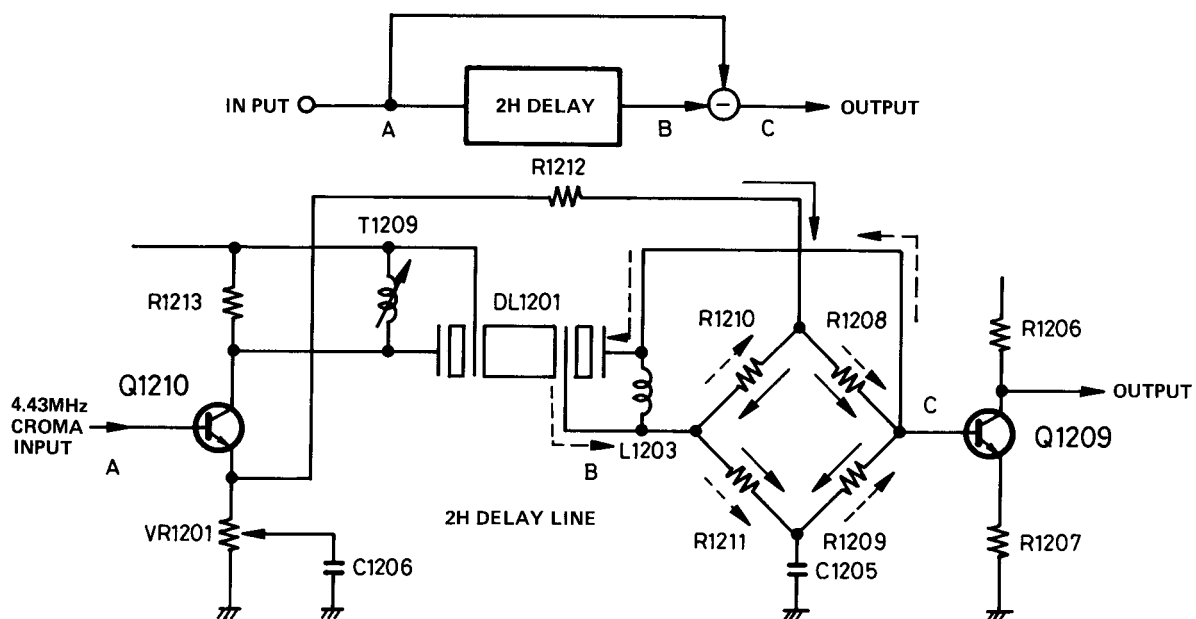


Fig. 2-1-26 Comb filter operation

(3) AFC circuit and APC circuit

Q1201 (CX-832) is the AFC and APC system IC, and is composed of the AFC circuit, the APC circuit, the 4.43-MHz reference oscillator, the 4.43-MHz VXO, and the frequency converter.

(a) AFC circuit

The 688-kHz continuous wave signal which multiplies the horizontal synchronizing signal by $(44 \pm 1/8)$ is obtained in the AFC circuit during both recording and playback. A PLL (Phase-Locked Loop) is employed to perform the

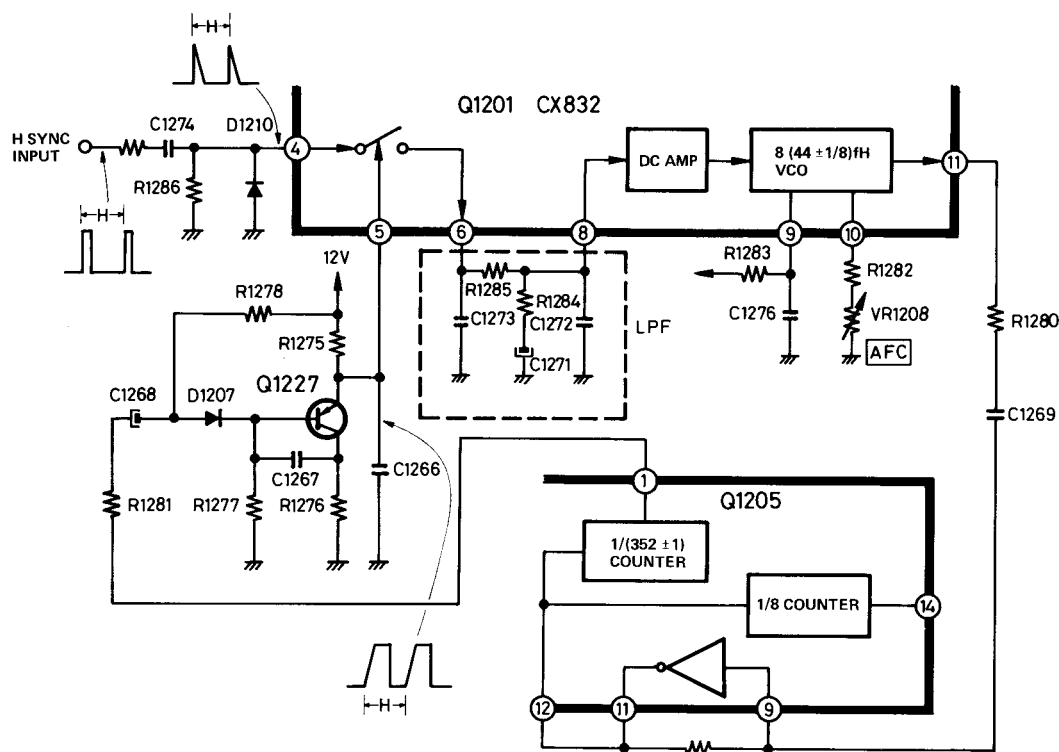


Fig. 2-1-27 AFC circuit

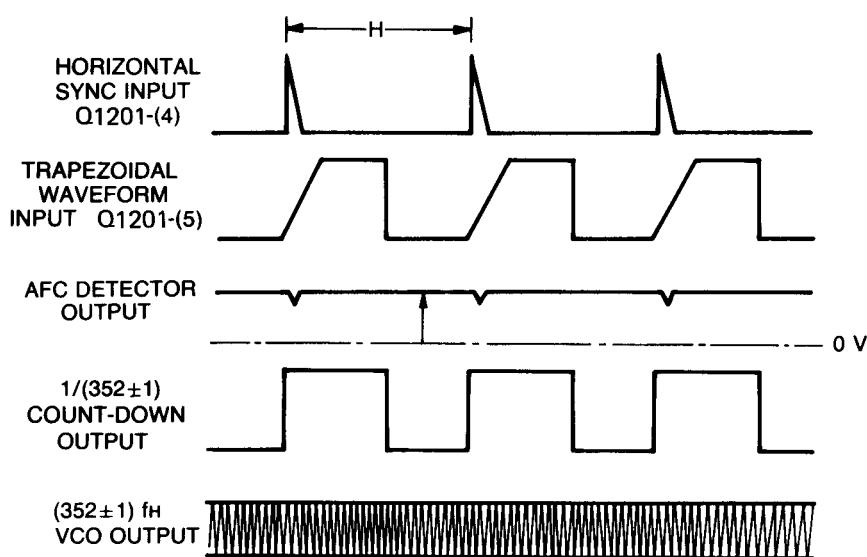


Fig. 2-1-28 AFC circuit waveforms

The oscillation output enters pin (12) of Q1205, and is supplied to the $1/(352 \pm 1)$ counter and to the $1/8$ counter. The $1/8$ counter output becomes a frequency of $(44 \pm 1/8)f_H$ and is supplied to the frequency converter of pin (14) of Q1201.

The sum of the output of this VXO and the 688-kHz $[44 \pm 1/8)f_H]$ output is obtained by the frequency converter, and converted to a frequency of 5.12 MHz, or in other

Fig. 2-1-29 APC circuit

words, $4.43 \text{ MHz} + (44 \pm 1/8)f_H$. This output (5.12 MHz) passes through the band filter from pin (15) of Q1201, and is then supplied to the chrominance frequency converter for both recording and playback. In the APC phase detector circuit, the recording 4.43-MHz chrominance signal passes through Q1212 and D1202 during recording, and the playback 4.43-MHz chrominance signal passes through Q1211 and D1202 during playback and both are supplied from pin (21).

The other signal that enters the APC phase detector circuit enters pin (23) and is supplied as the output of X1202 (VXO) during recording when Q1224 switches ON, or as the output of X1201 (the reference oscillator) during playback if Q1225 switches ON. This is summarized in Table 1.

Mode Phase comparison input	Record	Playback
Pin (21) Pin (23)	Recording chrominance signal (4.43 MHz) VXO output	Playback chrominance signal (4.43 MHz) Reference oscillator
Pin (24)	Burst flag	Pilot burst flag

Table 1

The phases of the pilot burst (intrinsic burst during recording) of the chrominance signal and the 4.43-MHz reference (VXO output during recording) are compared. The detector output is smoothed by the capacitor and resistor filters of pin (20) and pin (22), supplied to the VXO, and the 4.43-MHz frequency of X1202 is controlled.

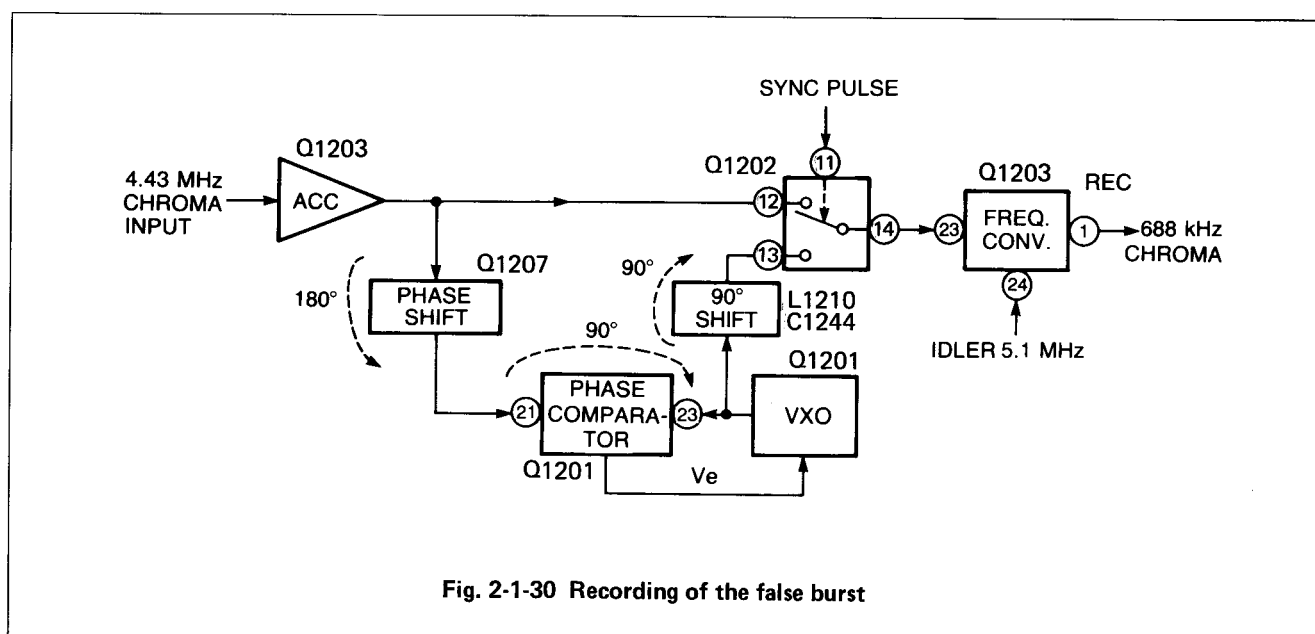


Fig. 2-1-30 Recording of the false burst

Because phase comparison is carried out by the pilot burst signal (the burst signal during recording), the function of the phase detector circuit is controlled by the burst gate circuit so that the APC phase detector output will gain only during the burst interval.

As for the burst gate pulse of pin (24), during recording, a burst flag (intrinsic) is supplied when Q1230 switches ON, and, during playback, a pilot burst flag (horizontal synchronizing signal part) is supplied when Q1229 switches ON.

In the NTSC format, f_{LA} and f_{LB} are defined by their respective absolute frequencies and allowable differences; however, in the PAL format, APC is performed during record because f_L is defined as a N-multiple of the various f_H . The burst for the APC is the frequency of the input subcarrier wave, and the phase is added at $-180^\circ \pm 10^\circ$ with respect to the phase of the V axis of the input subcarrier frequency. The composition of the APC during recording and the phase of the pilot (false) burst are shown in Fig. 2-1-30 and Fig. 2-1-31.

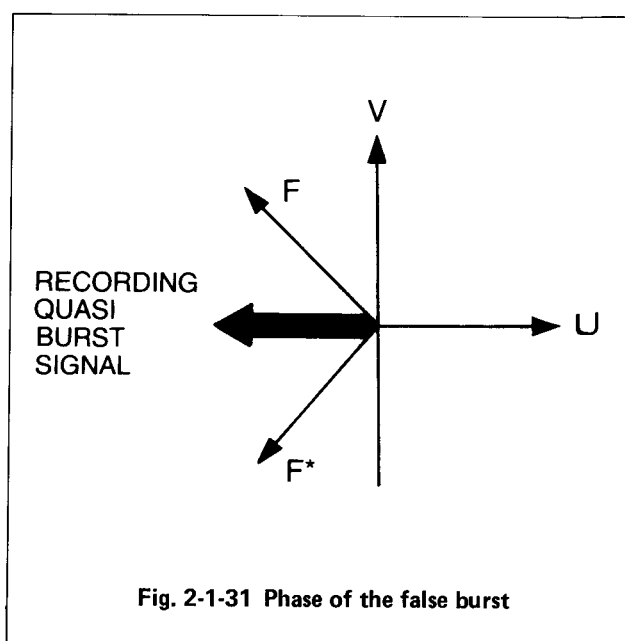


Fig. 2-1-31 Phase of the false burst

During recording, this pilot burst is utilized to apply the APC.

The 688-kHz chrominance signal played back by the video head possesses a $(44 \pm 1/8)f_H$ frequency relationship, and this signal includes phase fluctuations due to mechanism vibration, etc. This is first canceled by the phase fluctuation component included in the $(44 \pm 1/8)f_H$ PLL output of the AFC circuit. The remaining phase difference is detected by the APC circuit, and, by controlling the 4.43-MHz VXO, the phase fluctuation is eliminated, and a phase-stabilized 4.43-MHz chrominance signal is obtained. The horizontal pulse of the output of pin (7) of Q1205 forms the pilot burst flag by using Q1228, Q1229, and the AFC circuit of Q1201, and is then supplied to Q1204, Q1202, and Q1201. The horizontal pulse is differentiated by pin (4) of Q1201, and then a pulse whose negative side pulse has been cut by D1210 is supplied, and becomes the sampling gate signal of the AFC detection circuit. In addition, the horizontal pulse also becomes the comparison input of the audio muting circuit.

(4) Pilot burst ID circuit (APC checker)

Q1204 and CX-150 compose the pilot burst ID circuit. The block diagram for CX-150 is shown in Fig. 2-1-32. In the PAL format, because the recording frequency of the chrominance signal changes for each track, the in-rushing phase immediately after track switching depends upon the initial phase after AFC switching, and is generally indefinite. Therefore, a certain amount of time is required for the APC followthrough.

Because of this, the APC of the television set does not followthrough, and the hue at the top of the picture

becomes blurred. The pilot burst ID circuit is used to prevent this. (Refer to Fig. 2-1-33.) In other words, the pilot burst and the phase of the 4.43-MHz reference oscillator are compared, and, if the result is within the oblique line in Fig. 2-1-34, the chrominance phase is instantaneously reversed by the phase switch. As shown in Fig. 2-1-33, the burst ID loop is outside the APC loop, and does not influence it. In other words, the ID loop is for speeding up the lead-in of the APC of the television set. Also, because the ID loop is small, switching is rapid, and there is no transit error.

The 5.12-MHz carrier signal from pin (15) of Q1201 is phase-divided by the phase divider transformer T1204. The secondary phase divider output of T1204 is supplied to the switching circuit of pin (8) and pin (9) of Q1204. A regular phase 5.12-MHz carrier signal is applied to pin (8) and a reverse phase 5.12-MHz carrier signal is applied to pin (9). The operation of this switch is carried out by the output obtained from passing the flip-flop output and the input of pin (10) through the OR gate. During recording, a DC voltage is applied to pin (10), the switch is set to the pin (8) side, and the ID operation is stopped. The 5.12-MHz carrier signal from pin (6) is supplied to pin (24) of Q1203.

The playback 4.43-MHz chrominance signal is applied from Q1207 to pin (2) of Q1204, and becomes the phase comparison input. Here the phase of the 4.43-MHz crystal oscillator output [pin (11)] which is the reference signal of the PLAY mode and that of the pilot burst of the chrominance signal of pin (2) are compared, and when the phase is reversed 180° , a trigger pulse is obtained, passed through the OR circuit, and then applied to the

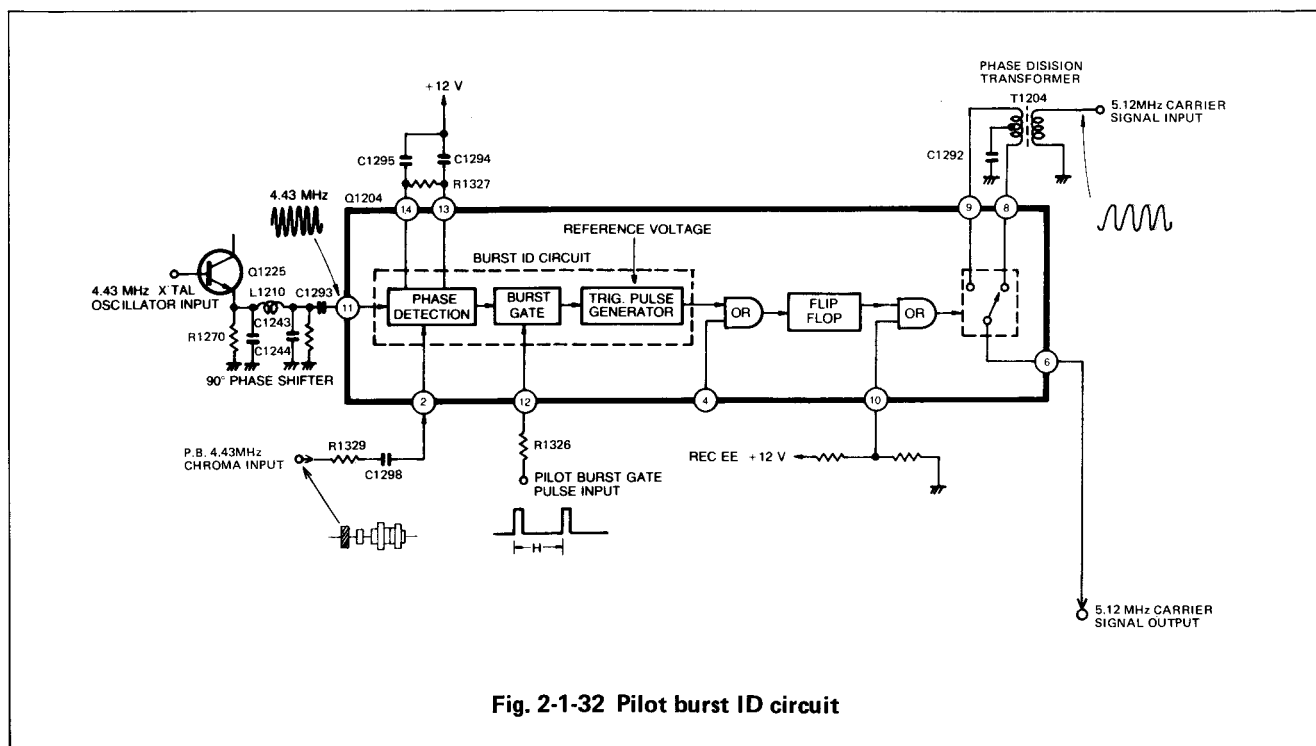
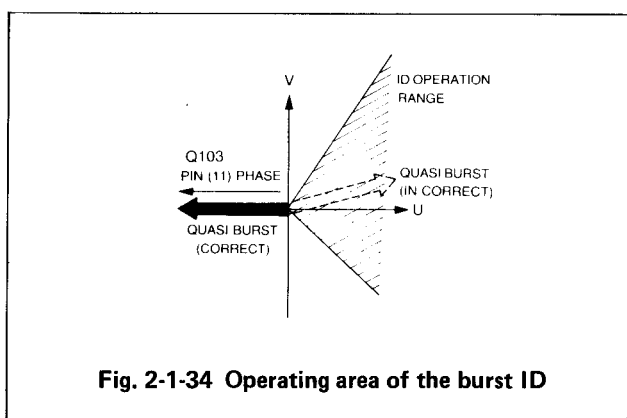
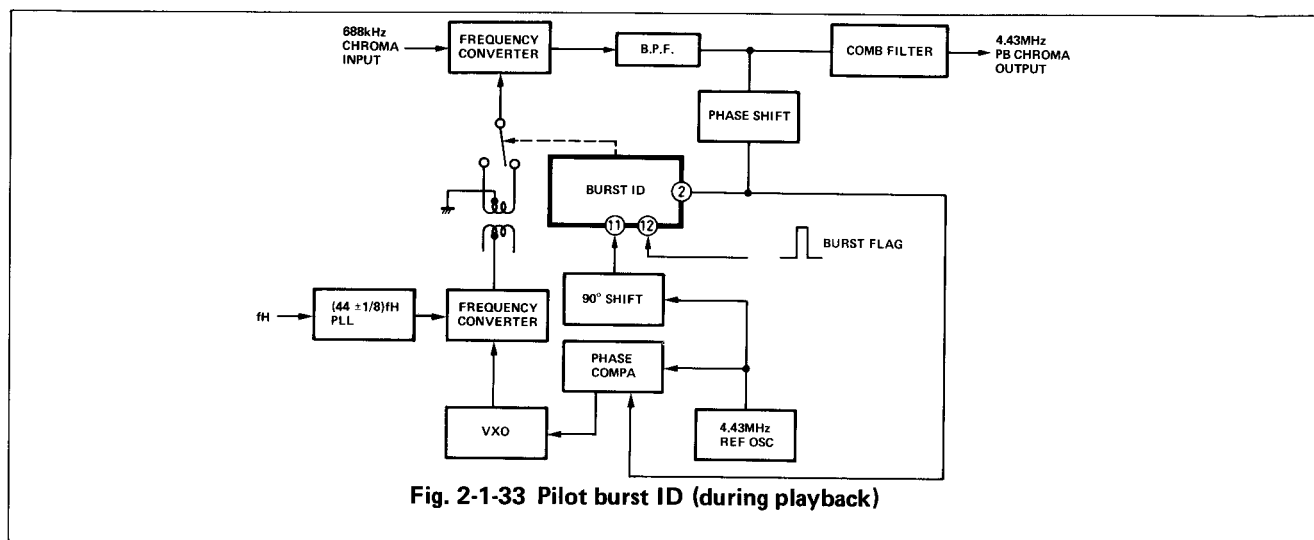


Fig. 2-1-32 Pilot burst ID circuit



flip-flop. Generally, while the APC is in the locked position, the relative phase difference between the pilot burst signal of the 4.43-MHz chrominance signal and the reference 4.43-MHz crystal oscillator output is 90° . Next, the reference 4.43 MHz is passed through a 90° phase-shift circuit, and made in-phase with a normal pilot burst, and then phase comparison is carried out. The capacitors and resistors located between pin (13) and pin (14) of the phase detector circuit are the filter for the detector output. The detector output smoothed here is applied to the burst gate. The burst gate operation is carried out by gating the pilot burst period of the phase detector output. The internal reference voltage and the detector output are compared in the trigger pulse generating circuit, and, when the phase of the pilot burst is approximately at 180° , the detector output voltage difference is detected, and a trigger pulse is formed.

(5) 50-Hz reference signal output circuit

At VD-2, this circuit generates the 50-Hz reference signal used in the servo circuit. During the REC mode, the vertical sync is extracted through performing sync separation by Q1238 and Q1239 on the video signal from pin (20) of Q1001 on VD-1. This vertical sync is then sent to the servo circuit.

During the PLAY mode, the 4.43-MHz reference oscillation frequency output is divided by Q1206 (M58478P), a 50-Hz signal is extracted, and this signal is sent to the servo circuit.

(6) Power supply circuit for the various modes

The various power supplies of REC + PAUSE + 12 V, PB + 12 V, and REC EE + 12 V are produced by the VD-1 circuit board. REC + PAUSE + 12 V is produced by Q1040 and Q1039, and PB + 12 V and REC EE + 12 V are both produced by Q1041 and RY1001.

During the EE mode, pin (2) of S1002 becomes HIGH, Q1041 switches ON, RY1001 moves to the NO side, and REC EE + 12 V is output.

During recording, REC EE + 12 V is output the same as for the EE mode. Also, because pin (3) of S1002 becomes HIGH, Q1040 switches ON, and REC + PAUSE + 12 V is output from the collector of Q1039.

During the PLAY mode, pin (2) of S1002 becomes LOW, Q1041 switches OFF, RY1001 moves to the NC side, and PB + 12 V is output.

(7) Audio muting circuit

Q1237 and Q1236 are the gate circuit for the corresponding horizontal pulses and the pulse of the horizontal frequency obtained from the AFC circuit. This gate circuit compares the two pulses, and detects whether the pulses are aligned. After this, the pulses are resonated to 15625 Hz by the resonance circuit of L1210 and C1305, the noise is eliminated, the pulses are rectified by D1213, D1212, and C1303, and the voltage needed to switch Q1235 ON is extracted.

Consequently, when a video signal is input, Q1 switches ON, and pin (3) of S1201 becomes LOW; when a video signal is not input, pin (3) of S1201 becomes HIGH. This signal causes the audio muting circuit of the tuner to function.

In addition, the switching of the time constant of the AGC circuit of VD-1 is carried out by this signal.

III. SERVO CIRCUIT

1. Producing the PG Pulse

In order to detect the revolution speed and the revolution position of the video head, a PG coil and a magnet are utilized. The relative positions of these are shown in Fig. 2-2-1.

When the video head disc revolves and the video head reaches the position 8° in front of the switching position, a PG-A pulse and a PG-B pulse are generated. The PG-A pulse and PG-B pulse are applied to pin (1) of Q4001. A block diagram of the servo circuit is shown in Fig. 2-2-2.

2. Producing the Video Head Switching Pulse from the PG Pulse

After the PG pulse has been amplified by the PG-A and PG-B wave detectors, the resulting signals are converted to a 25-Hz square wave by FF1. This square wave is supplied to switching position delay B, and is also sent to speed MM1 of the speed control circuitry, and gate pulse 2. In switching position delay B and switching position delay A, the square wave is delayed by approximately 0.89 milliseconds (equivalent to the 8° between the position of the PG coil and the position of the mag-

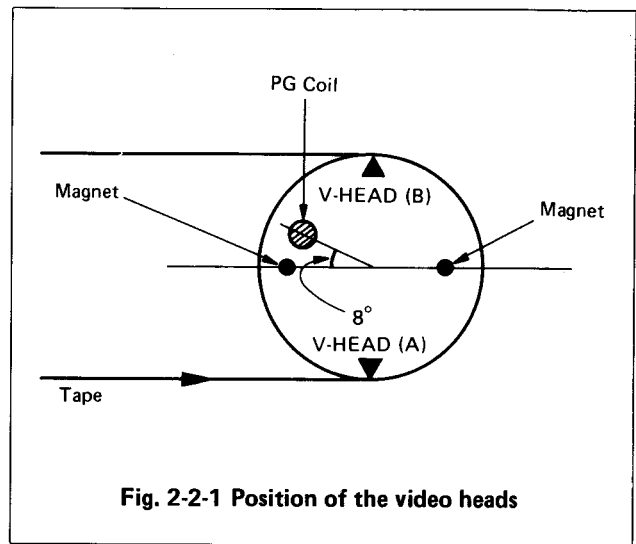


Fig. 2-2-1 Position of the video heads

net), and any mechanical errors, such as the mounting position of the PG coil, etc., are corrected. For the period that the video head switching pulse (RF switching pulse) which is input to pin (4) of Q4001 is HIGH, head B operates, and for the period that this pulse is LOW, head A operates.

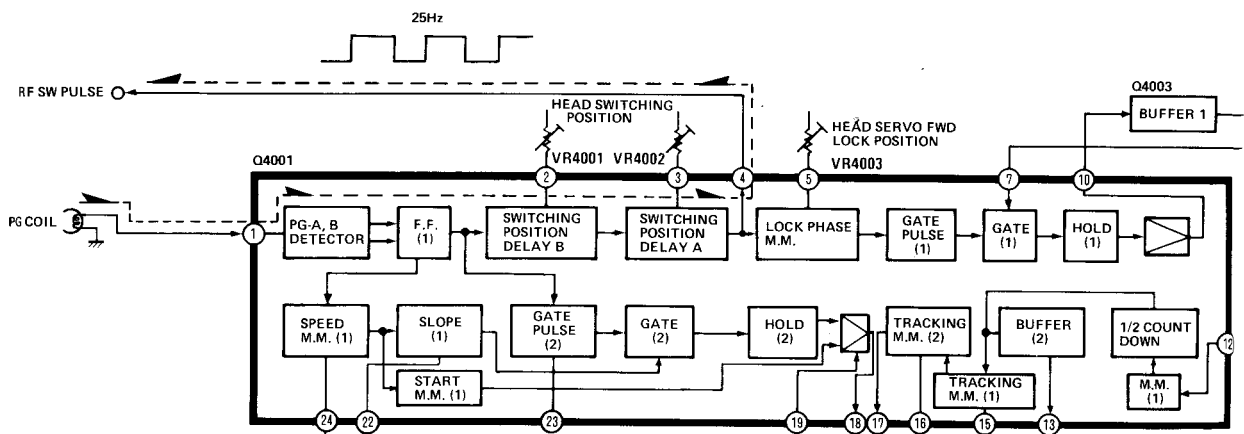


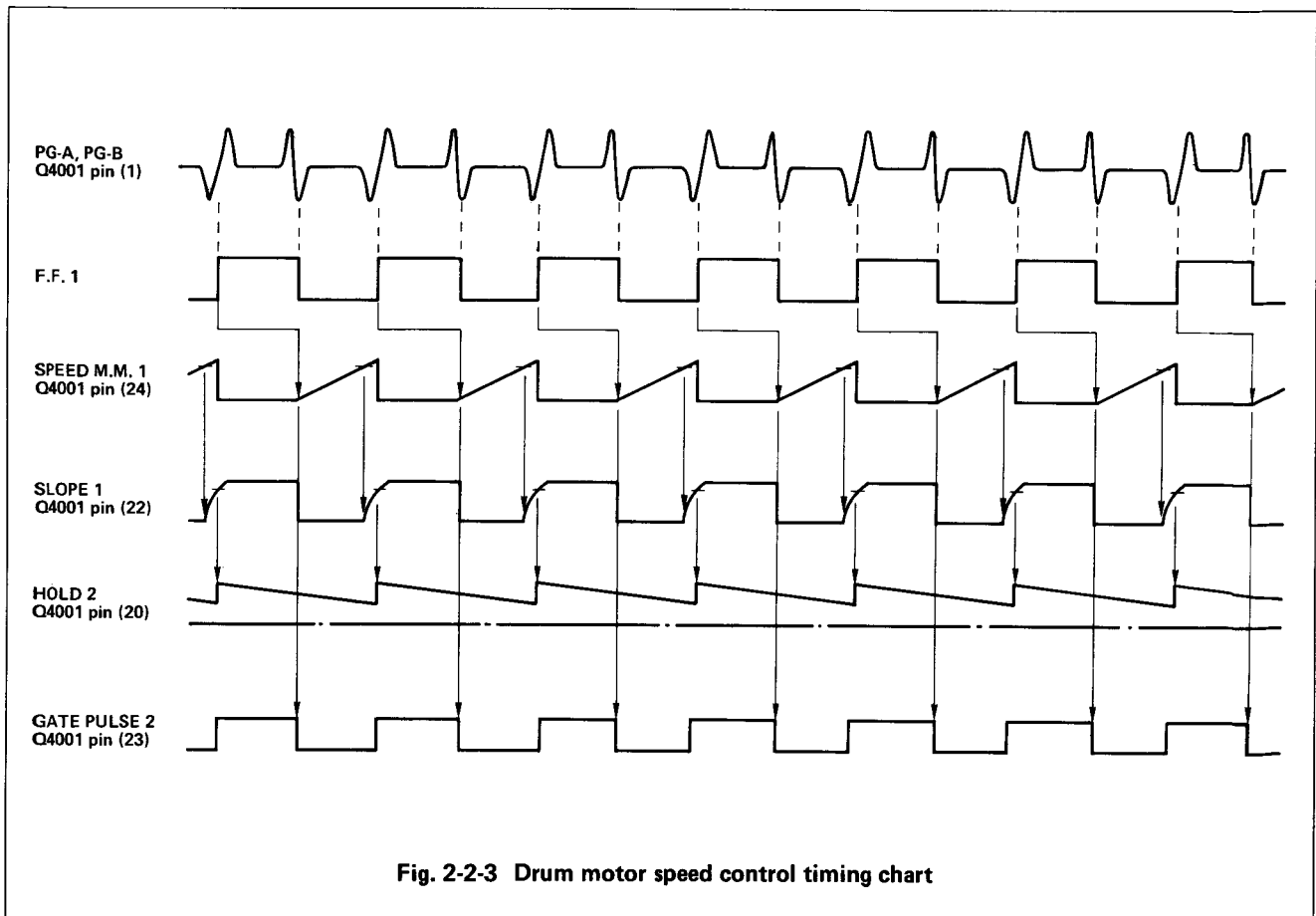
Fig. 2-2-2. Servo circuit block diagram

3. Controlling the Speed of the Drum Motor

When a phase servo is used for a DC motor, a circuit that will increase the rpm of the motor up to the level of rpm applied to the phase servo is necessary. The speed control circuit performs this function for the drum motor. The PG pulse is delayed by speed MM1, and a trapezoidal wave is produced by slope 1 [pin (22) of Q4001]. The gate pulse for the PG-B pulse is produced by FF1 and gate pulse 2 [pin (23) of Q4001]. The gate pulse and the trapezoidal wave are passed through gate 2, this gated voltage is held at hold 2, and, after current amplification, is sent from pin (18) of Q4001 to the drum motor drive circuit. Starter 1 operates when the rpm of the motor is

low (less than approximately 750 rpm) to forcefully drive the motor, so that the servo is quickly applied.

Starter 1 is an integrating circuit whose time constant is composed of the externally mounted capacitor and resistor. Integration begins when the PG-A pulse is generated, and is reset by the generation of the PG-B pulse. During constant rotation (1500 rpm), resetting is activated before the charging voltage of the capacitor reaches the threshold voltage (6 V), and the start pulse is not output. When the motor begins to rotate, or when its rpm is low, the integration time is long. Charging is then continued past the threshold voltage, and the start voltage is generated.



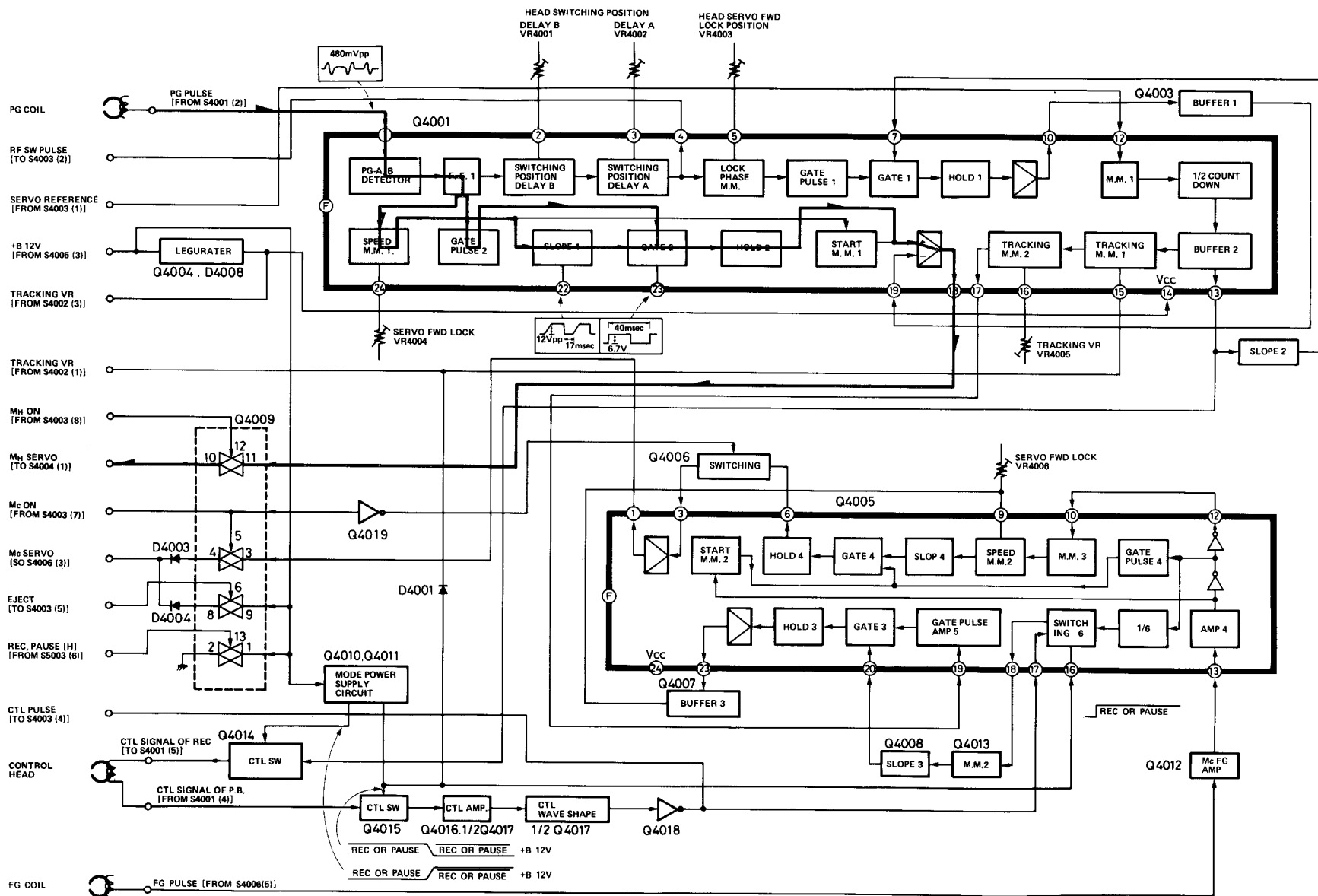


Fig. 2-2-4 Servo circuit block diagram (Drum Motor speed control)

4. Control of the Drum Motor Phase

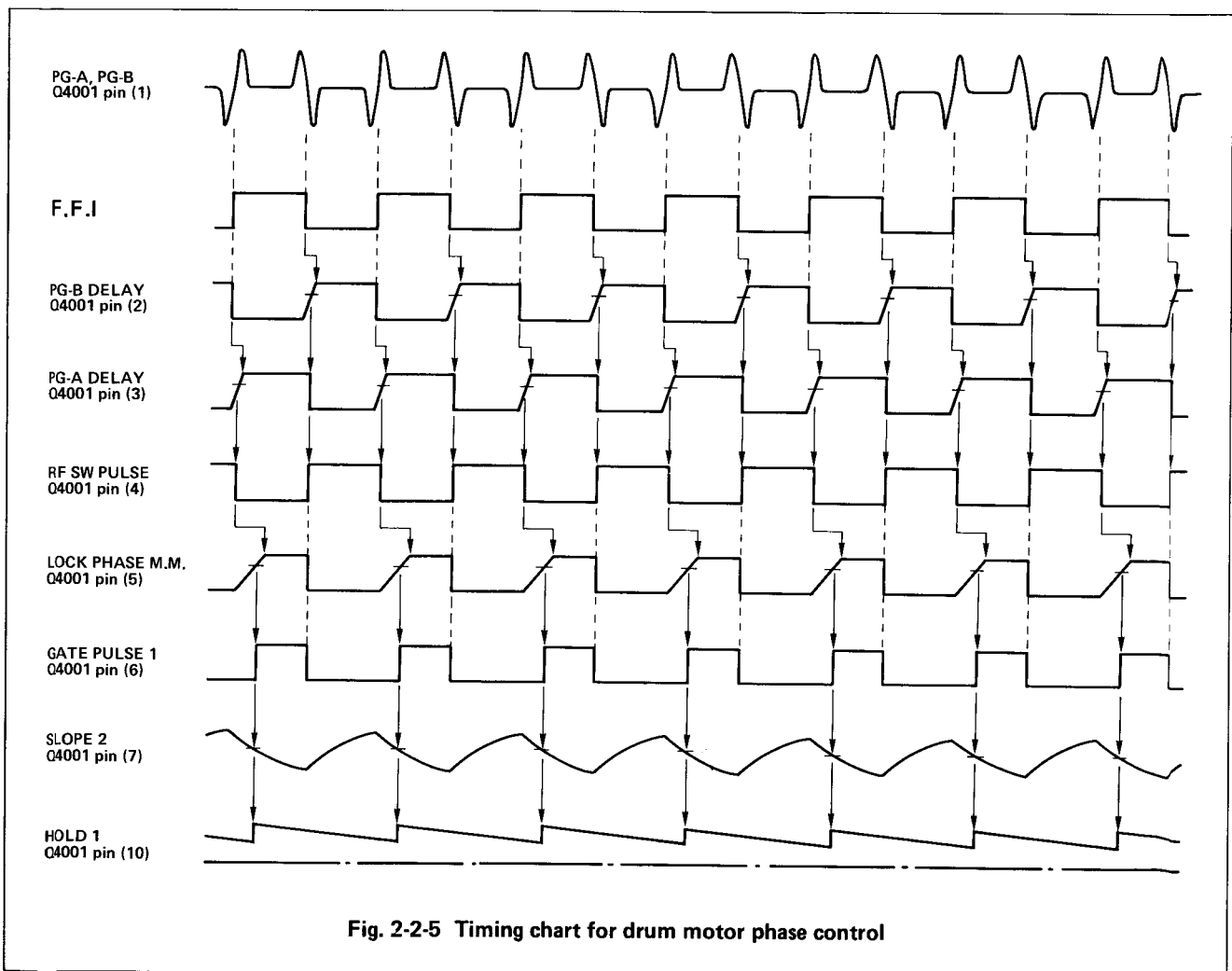
During recording, the revolution phase of the video head must be synchronized with the video signal (i.e., the position at which the video head begins to trace the cassette tape must be 7H before the front edge of the vertical synchronizing signal of the video signal); furthermore, during playback, the pattern recorded on the tape must be accurately traced by the same head as the recording head. The time that head A begins recording becomes a control signal and is recorded onto the lower edge of the tape by the control head, and, during playback, the recorded control signal is played back. In order that the tracing function of head A begins at this playback time, phase control is applied to the drum motor. Actually, a capstan servo system is employed, the video head rotates in synchronization with the reference signal which is formed by the crystal and the frequency divider circuit. The playback control signal is supplied to the capstan servo circuit, and the tape speed is controlled so that there is a fixed relationship between the reference signal and the phase. Therefore, the reference signal acts as an intermediary, and thus the rotation

phase of the video head is synchronized with the playback control signal.

The vertical synchronizing signal of the video signal during recording, and the signal which is formed by the crystal during playback (both of these signals are formed by the VD-2 circuit board), are both applied to pin (12) of Q4001. In addition, after this signal is made highly noise-resistant by MM1, it is formed into a square wave of 25 Hz by the 1/2 countdown.

The signal which indicates the rotation phase of the video head is the trailing edge of the video head switching pulse (PG-A); this signal is delayed by the lock phase MM, passes through gate pulse 1, becomes the gate signal, and is sent to gate 1.

The reference signal of 25 Hz is output from pin (13) of Q4001, becomes a trapezoidal wave at slope 2, and is then sent to pin (7) of gate 1. After the gated voltage is held at hold 1 and current amplified, it is output from pin (10) of Q4001, passes through buffer 1 (Q4003), compared to the speed control voltage, added, and then supplied to the head motor drive circuit.



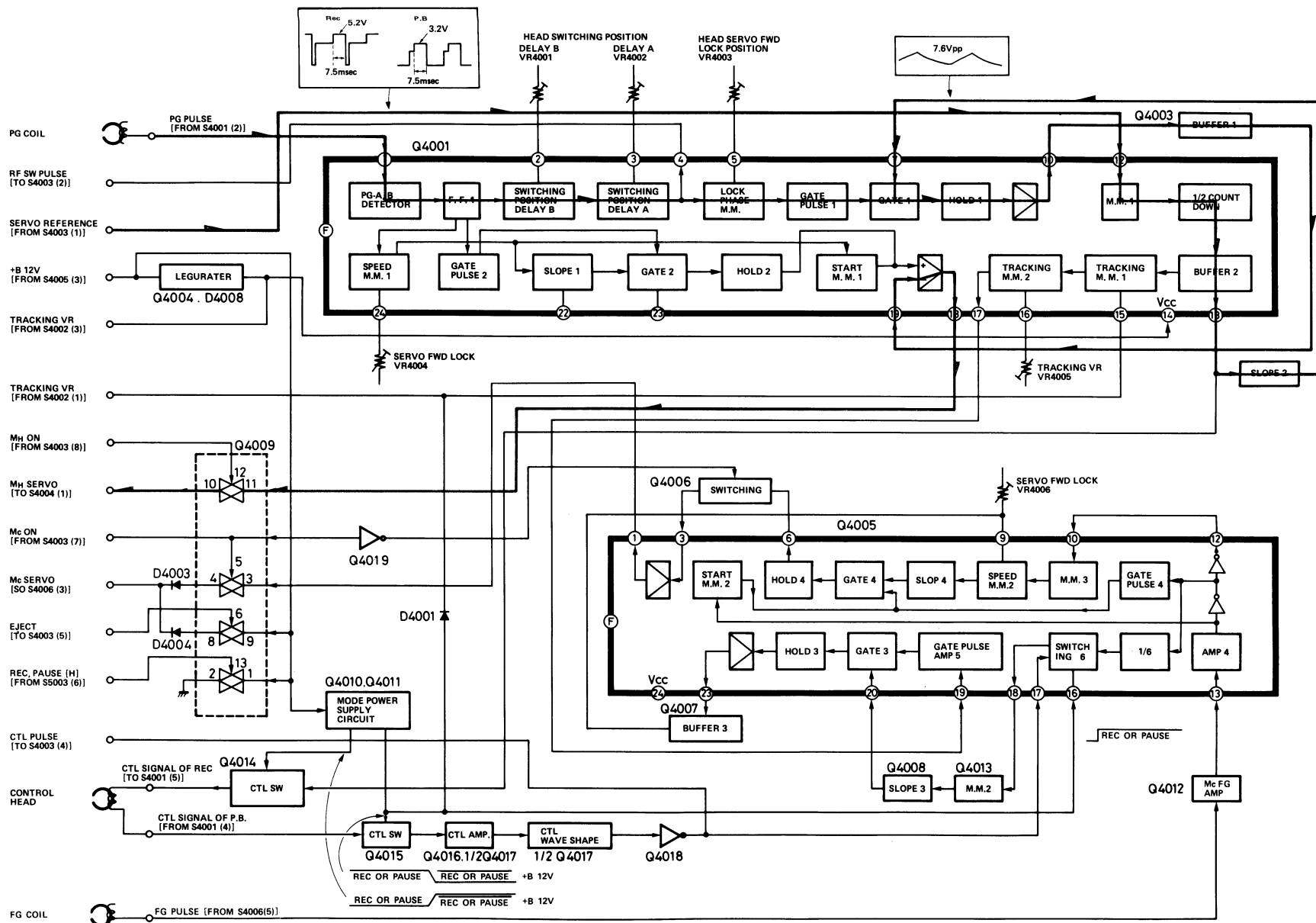
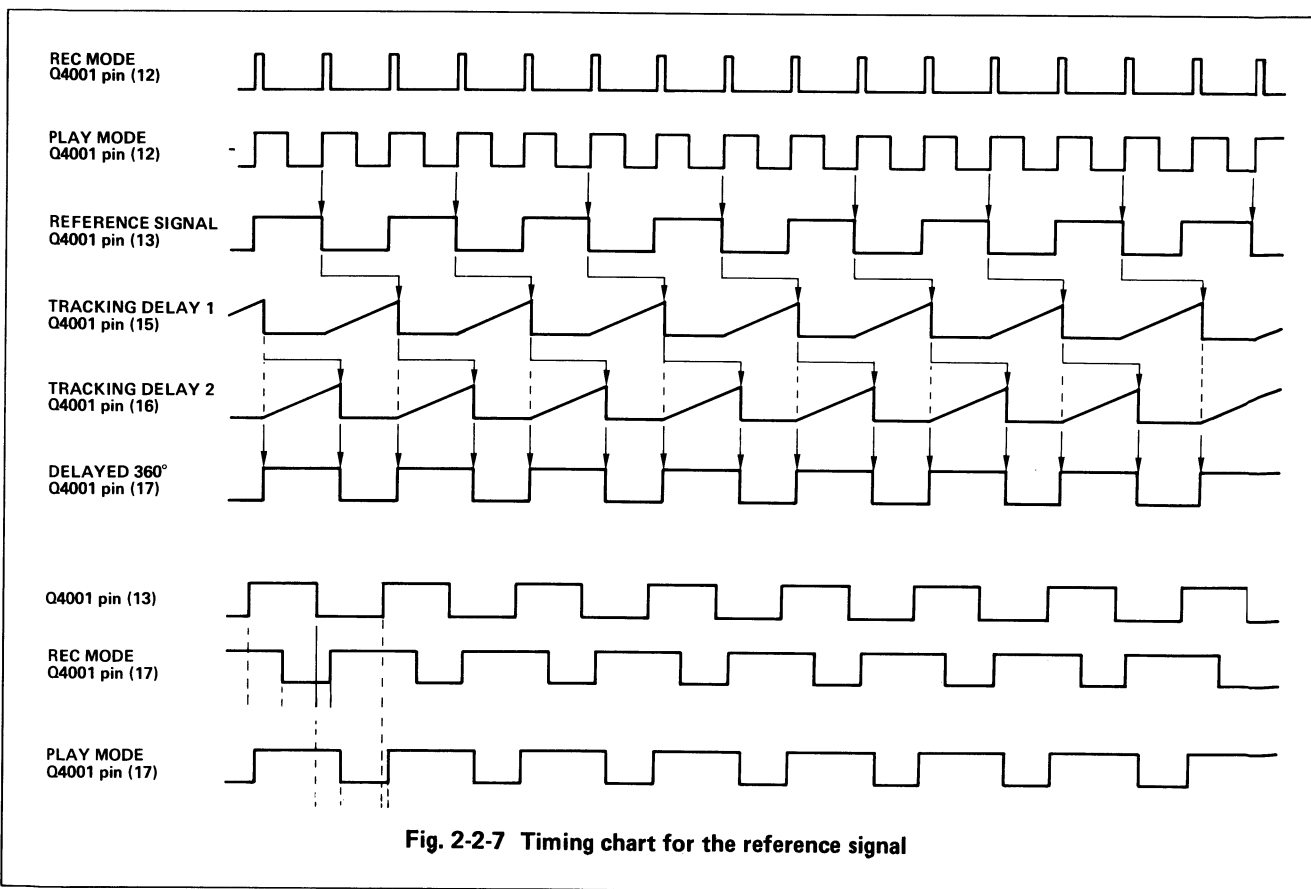


Fig. 2-2-6 Servo circuit block diagram (Drum Motor phase control)

5. Delay of the Reference Signal by 360° (Tracking)

When playing back a cassette tape which has been recorded on a different VCR unit, if there is a difference in the mounting position of the control head between the recording unit and the playback unit, the playback time of the control signal will be misaligned in proportion to the amount of difference in the position. Therefore, the picture on the television screen will be affected by a considerable amount of noise, making viewing difficult. The circuit which electrically corrects this mechanical misalignment consists of tracking MM1 and tracking MM2

of Q4001. If the position of the control head on the recording unit is misaligned to the negative side of that on the playback unit, the playback time of the control signal will be delayed. In order to align the phase, the playback time must be speeded up. Accordingly, a playback time which is delayed one cycle is adjusted by adjusting the tracking VR which is the time constant circuit of tracking MM2, shortening the delay time, and producing a delayed time which is delayed for slightly less than one cycle. This delayed time is then supplied to the phase control circuit as the playback time of the control signal.



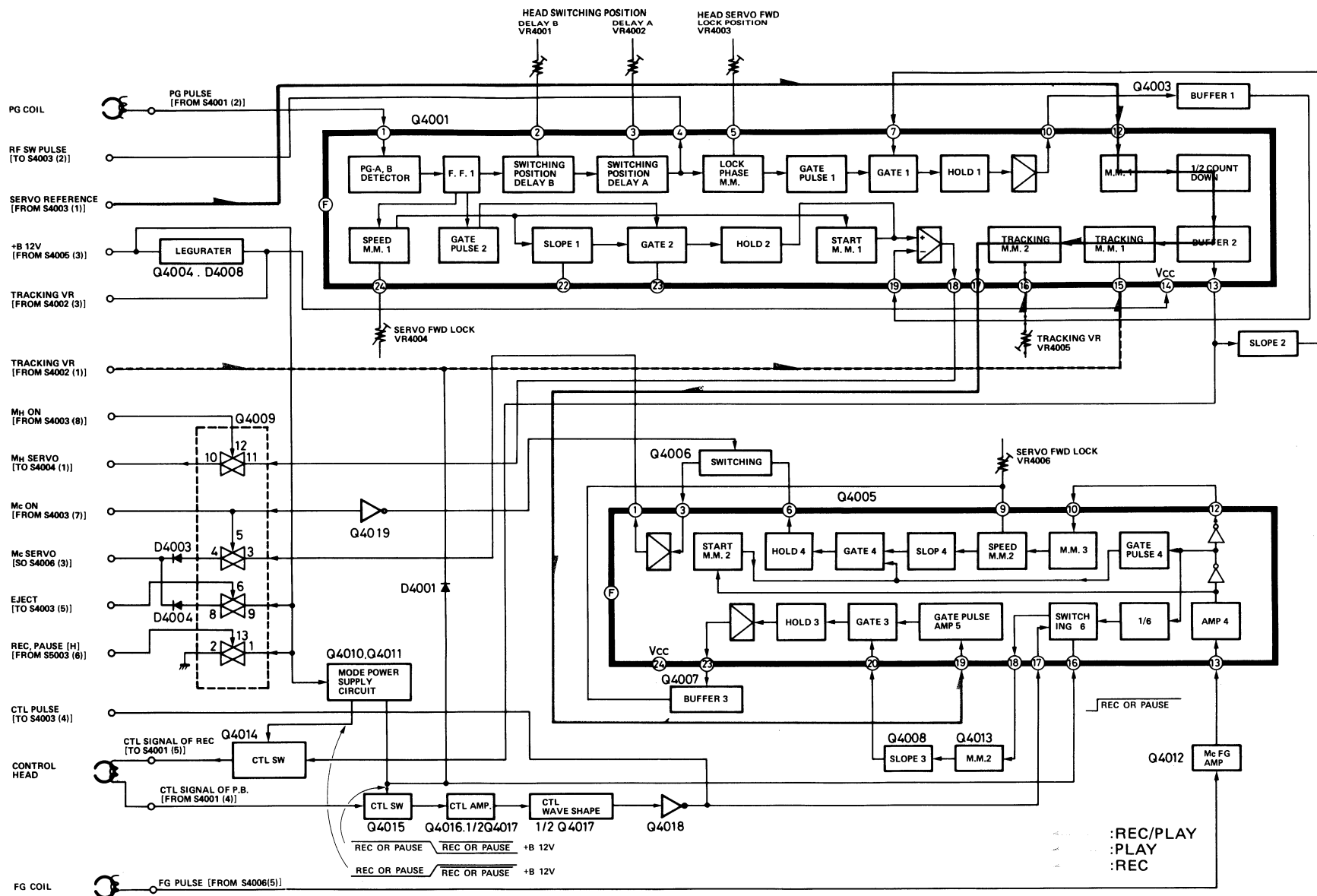


Fig. 2-2-8 Servo circuit block diagram (Delay of reference signal)

6. Controlling the Speed of the Capstan Motor

This speed control circuit is almost identical to the speed control circuit of the drum motor. After the trailing edge of the FG pulse which is input to pin (13) of Q4005 is delayed at MM3 and speed MM2, a trapezoidal wave is formed by slope 4, and sent to gate 4 of the gate circuit. The FG pulse which is inverted by the inverter passes

through gate pulse 4, and is sent to gate 4. This gate pulse gates the trapezoidal wave at the rise section of the FG pulse, and holds the gated voltage at hold 4.

After the held voltage is current amplified, the capstan servo discrepancy voltage passes from pin (1) of Q4005 through the switching IC (Q4009), and is supplied to the capstan drive circuit.

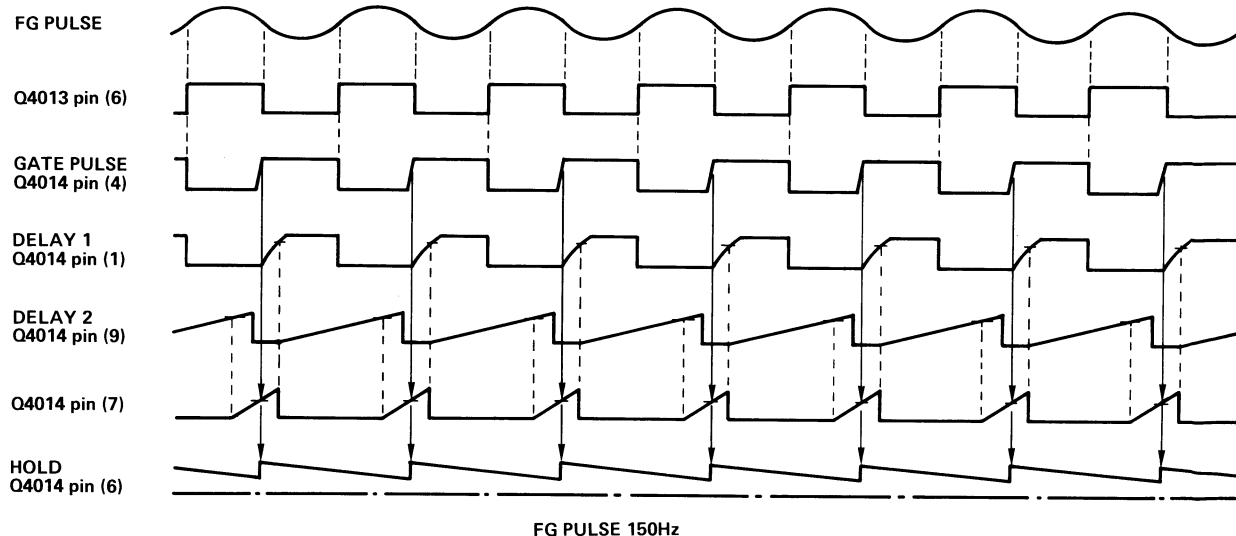


Fig. 2-2-9 Timing chart for capstan motor phase control

7. Frequency Division of the FG Pulse

During recording, it is not necessary to determine the rotation phase of the capstan motor; however, by applying phase control, the rotation of the motor can be precisely controlled. The reference signal of 25 Hz which is employed by the control circuit of the drum motor is also employed as the reference signal of the capstan motor. Therefore, a frequency divider circuit to change

the FG pulse to 25 Hz is required.

Because the FG pulse is a frequency of 150 Hz, it must be 1/6 frequency divided. The FG pulse which is input to pin (13) of Q4005 passes through amplifier 4 and the inverter, is divided down to 25 Hz by the 1/6 frequency divider, passes through switching 6, and is output to pin (18) of Q4005. Pin (15) and pin (14) are earthed, and fixed to the 1/6 frequency divider.

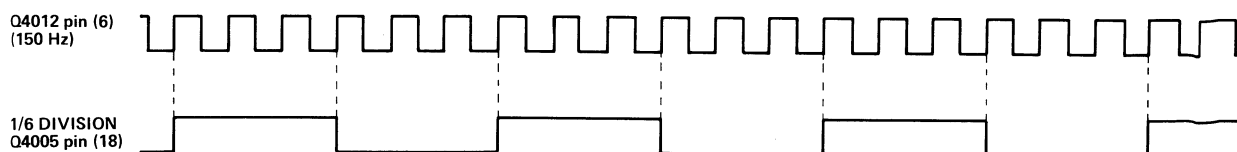
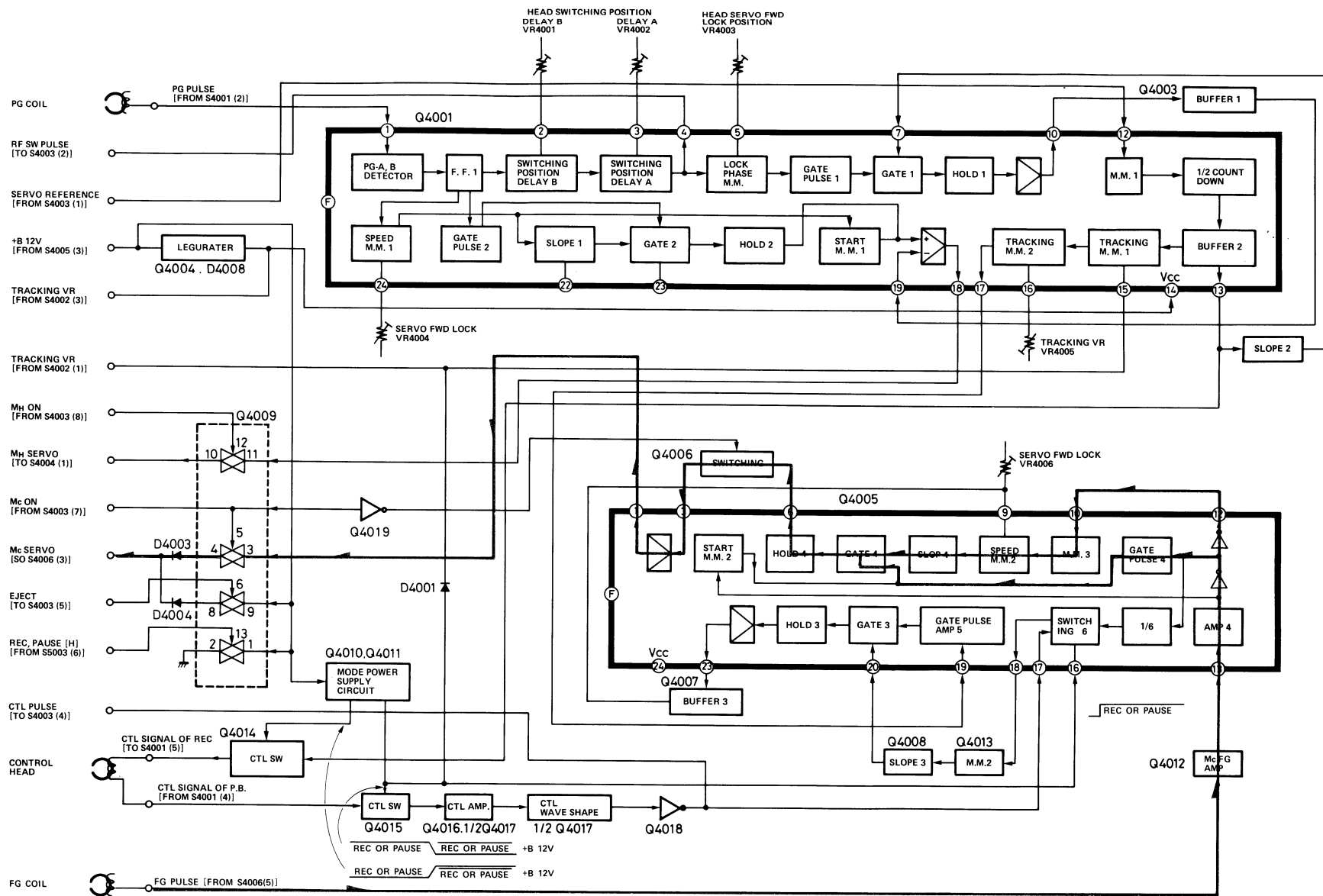


Fig. 2-2-11 Timing chart for FG pulse division



8. Phase Control of the Capstan Motor

During playback, the signal is extracted from the control head, and passes through the control amplifier (Q4016 and Q4017). The playback control signal which is shaped into a square wave passes through the inverter (Q4018) and MM2 (Q4013), is shaped into a trapezoidal wave by slope 3 (Q4008), and then sent to gate 3 [pin (20) of Q4005]. As for the gate pulse, the signal which delayed the reference signal by 360° at tracking MM1 and tracking MM2 of Q4001 enters gate 3, and the trapezoidal wave is gated. After this gated voltage is held at hold 3 and current amplified, it then passes through buffer 3 (Q4007), and is sent into the speed control circuit.

During recording, the FG pulse which was 1/6 frequency divided passes through the MM2 IC (Q4013), is shaped into a trapezoidal wave by slope 3 (Q4008), and is then sent to gate 3 [pin (20) of Q4005]. The gate pulse is output from pin (17) of Q4001 just as it is during playback; however, because a section of the time constant circuit of tracking MM1 is the tracking VR (VR4004), switching 4 (D4001) is employed so that the delay time of tracking MM1 does not change, even if the tracking VR (VR4005) varies. The trapezoidal wave of the FG pulse is gated by this gate pulse, and then, just as during playback, is held at hold 3, current amplified, and sent to the speed control circuit.

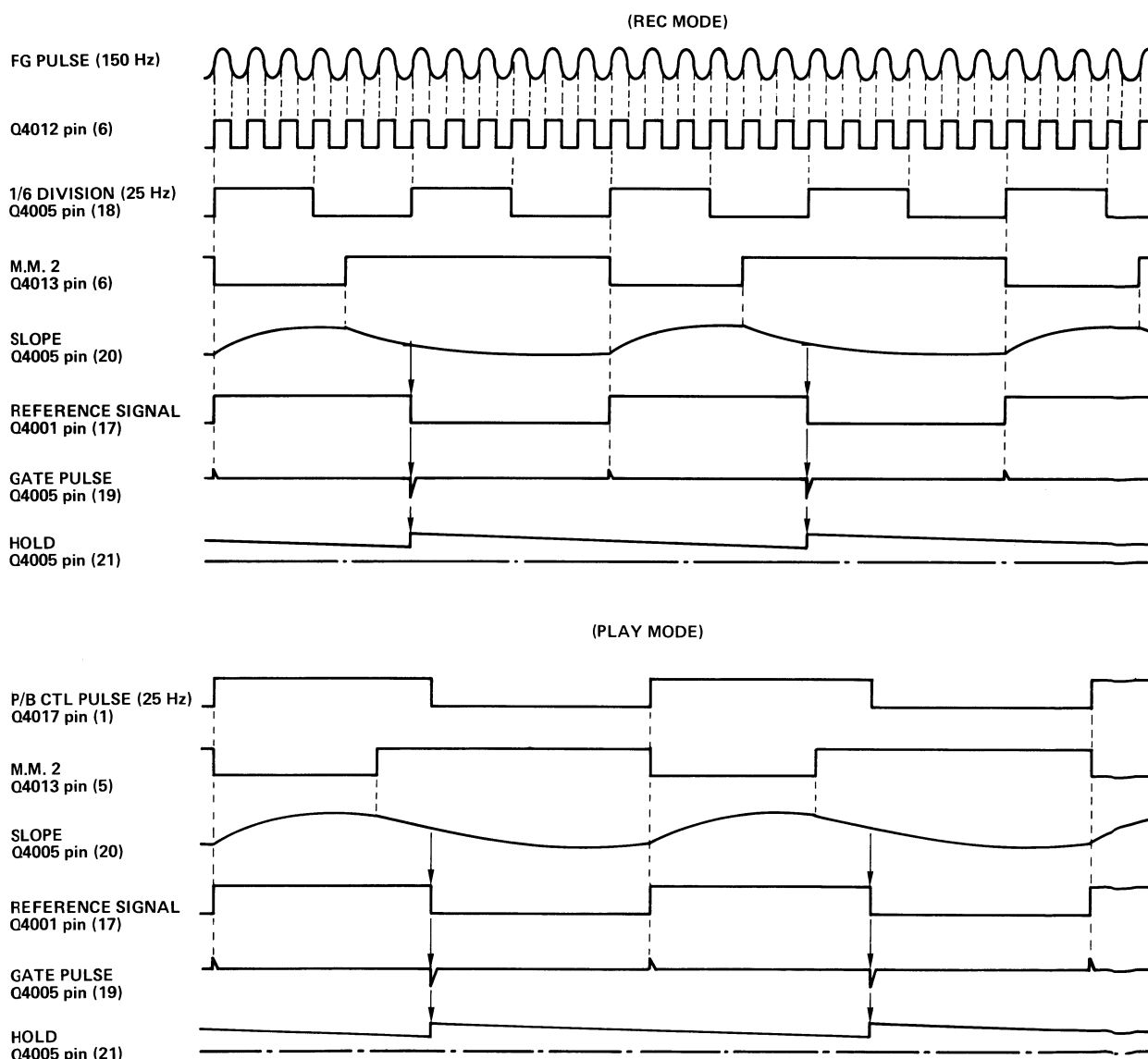


Fig. 2-2-12 Timing chart for capstan motor speed control

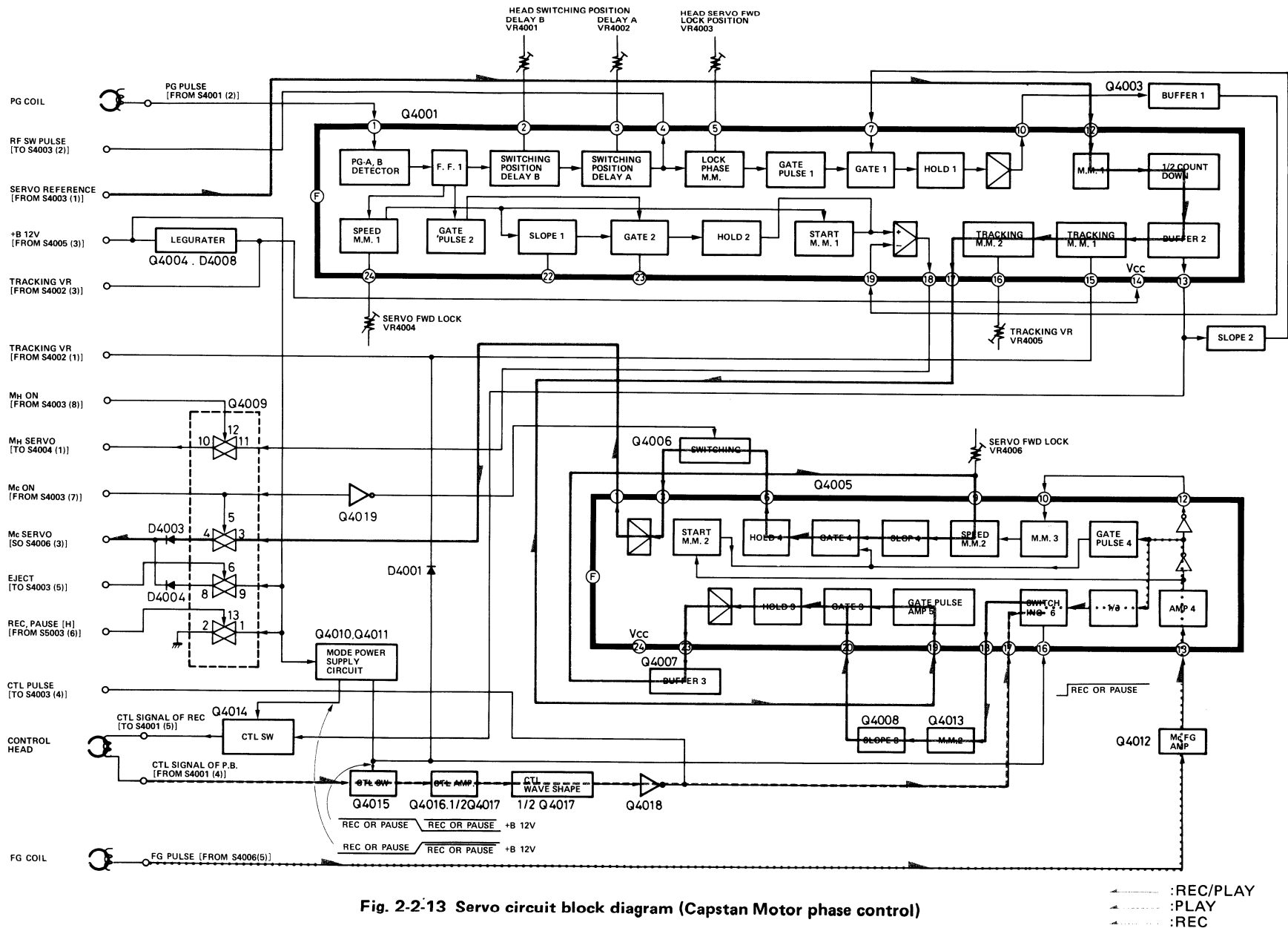


Fig. 2-2-13 Servo circuit block diagram (Capstan Motor phase control)

9. Smooth Starting of the Capstan Motor Rotation (Q4019 and Q4006)

When the capstan motor is not in motion (i.e., when the Mc ON signal is LOW), capacitor C4012 for the equalizer of pin (3) of Q4012 is charged, and, if the motor is rotated at this time (i.e., the Mc ON signal becomes HIGH), a high voltage is output from pin (1) of Q4012 as the capstan control voltage. Thus, the motor suddenly begins to rotate, without having a smooth start. Therefore, if, when the capstan motor is not in motion, the charging voltage is adjusted so that it decreases, the motor will begin to rotate slowly with a smooth start. This adjustment is made by the circuit composed of Q4006 and Q4019. The Mc ON LOW level is inverted by Q4019, and Q4006 is switched ON.

10. Capstan Motor Rotation During Eject Operation

When a cassette is to be ejected, the capstan motor is rotated in order to trigger the eject lever. When the eject signal from the system control circuit enters pin (6) of Q4009 (analog switch), the capstan control signal is output from pin (8) through D4004, and the motor begins to rotate.

11. Power Supply Stabilization of the Head Motor Servo IC (Q4004)

By means of a transistor Q4004 and a zener diode (D4008), the supply voltage of the head motor servo IC (Q4001) is made constant so that the head servo circuit maintains stable operation with regard to fluctuations in the power supply.

12. Power Supply for the Various Modes (Q4010 and Q4011)

This circuit supplies the two types of voltage required by the servo circuit, 12 V during recording and 12 V for playback.

13. Recording and Playback of the Control Signal (Q4014 ~ Q4017)

The vertical synchronizing signal (reference signal) which is input to pin (12) of Q4001 during recording is 1/2 frequency divided. This frequency divided vertical synchronizing signal is recorded onto the lower edge of the tape by Q4014 as the control signal which indicates the recording position of the video signal.

During playback the control signals which are played back through Q4016 and Q4017 are amplified, changed into square waves, passed through the Q4018 inverter, and then sent to the system control circuit and pin (17) of Q4005. The recording head for the control signal is also the playback head. Q4014 and Q4015 are switched (each is switched so that the terminal is earthed) by the recording 12 V and the playback 12 V, respectively, thus using the head for both recording and playback, as appropriate.

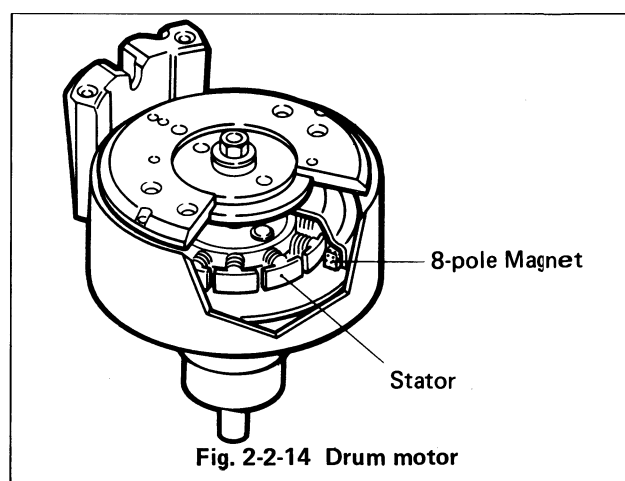
14. FG Amplifier (Q4012)

Because the signal generated by the frequency generator (FG) of the capstan motor is small and in the form of a sine wave, it cannot be used as a servo signal. Therefore, the Q4012 FG pulse amplifier serves the function of amplifying this FG signal and changing the waveform into a square wave.

15. Head Motor and Capstan Motor

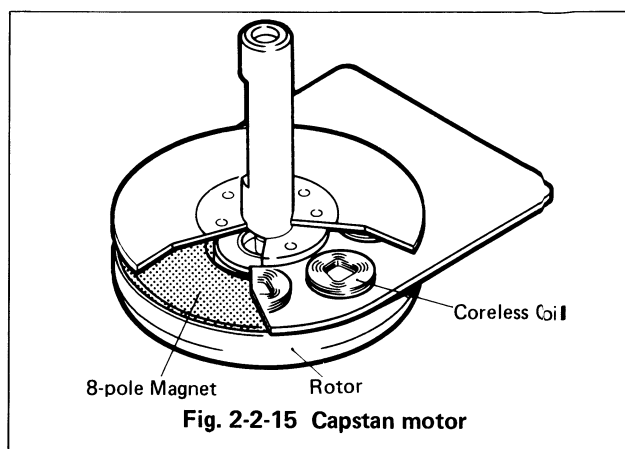
a. Head motor (video drum drive motor)

The head motor employs an 8-pole magnet as the rotor and a 3-phase drive stator with a total of 12 coils (four coils for each phase) wound around a core having 12 protruding poles. This is an outer-rotor type brushless motor, and is a direct-drive system. In addition, Hall-effect elements are used for position detection of the rotor.



b. Capstan motor

The capstan motor is a flat-type coreless, brushless motor which employs an 8-pole magnet as the rotor and a 3-phase stator with a total of six air-core coils (two coils for each phase), and is also a direct-drive system. Hall-effect elements are used for position detection of the rotor.



c. Fundamental operation of a brushless motor

In a brushless motor, magnets are used in the rotor and drive coils are used in the stator. Position detectors (Hall-effect elements, for example) for the rotor, as well as a commutation circuit are necessary in order to assure smooth rotation of the rotor. The position detectors and the commutation circuit are the parts of a brushless motor which are equivalent to a brush and a commutator.

The position detectors and the commutation circuit must perform the function of electronically switching the drive coils, which must cause current to flow, according to the mutual positions of the drive coils and the rotor magnets.

A 3-phase drive brushless motor will be considered as an example. Fig. 2-2-16 is a simplified illustration of the circuit. There is a 3-phase (L1, L2, and L3) drive coil. Hall-effect elements (Q1, Q2, and Q3) used as position detectors are arranged at electrical angles of 120° intervals. When power is input under these conditions, one (Q1 for example) of the position detectors (Q1, Q2, and Q3) emits a HIGH signal as output. As a result, continuity exists only for transistor Q4, and current flows to L1, thus causing the rotor to rotate. Next, only Q3 emits the HIGH signal as output, continuity exists only for Q5, current flows to L2, and the rotation of the rotor is continued. As a result, only Q3 emits the HIGH signal as output, continuity exists only for Q6, current flows to L3, and rotation continues. In this way, the rotor is rotated by the flow of current to the 3-phase drive coil in the order L1 $\rightarrow$ L2 $\rightarrow$ L3 $\rightarrow$ L1.

As described previously, because the rotation is smooth, due to the position detectors (Q1, Q2, and Q3) and the commutating circuit (Q4, Q5, and Q6) repeating their switching ON and OFF in order with no duplication and no interruption, a differential-like action is created in the commutation circuit, and, for the 3-phase drive system, the commutation circuit is usually composed of a three-differential circuit.

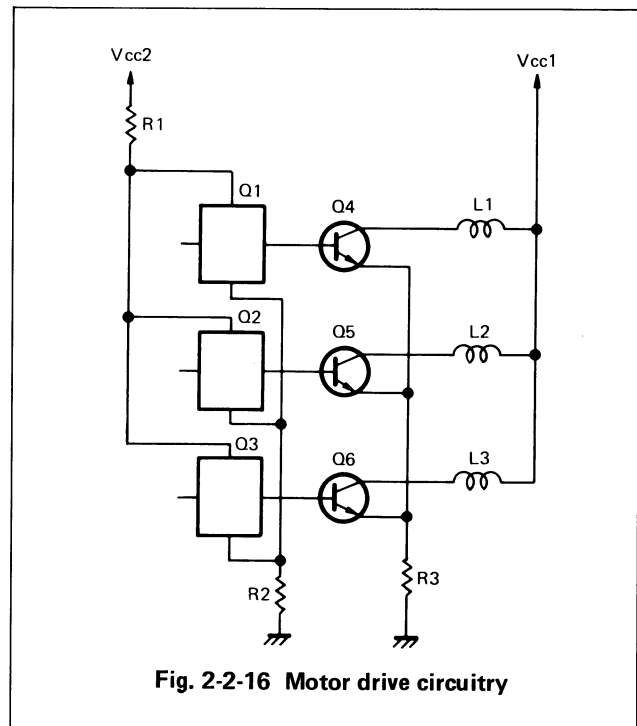


Fig. 2-2-16 Motor drive circuitry

d. Fundamental operation of the head motor

The head motor is composed of mainly two IC chips and three Hall elements.

The circuit diagram in Fig. 2-2-17, and the waveforms shown in Fig. 2-2-18 will be used for the explanation of the fundamental operation of the head motor drive circuit.

The head motor has three Hall elements (Q4351, Q4352, and Q4353) arranged in locations corresponding to each drive coil of each phase. The output signals from these three Hall elements are output as the waveform shown in Fig. 2-2-18 (a) according to the positions of the rotor magnets. The signal from Q4351 is input to pin (15) and pin (16) of Q4354, the signal from Q4352 is input to pin (13) and pin (14), and the signal from Q4353 is input to pin (11) and pin (12).

Because the output of the Hall elements is very fine, the various outputs are amplified within Q4354, and then input to the three-differential circuit. This three-differential circuit is the switching circuit by which the current flowing to the drive coil is electronically switched in order. Following this, the output signal of the three-differential circuit is amplified, and then, output signals such as that shown in Fig. 2-2-18 (b) are output, as follows: The output corresponding to Q4351 is output to pin (17) and pin (1) of Q4354, the output corresponding to Q4352 is output to pin (2) and pin (3) of Q4354, and

the output corresponding to Q4353 is output to pin (4) and pin (5) of Q4354.

The output of Q4354 is input in order to drive Q4355. In other words, the respective inputs are as follows:

From pin (17) of Q4354 to pin (3) of Q4355

From pin (1) of Q4354 to pin (2) of Q4355

From pin (2) of Q4354 to pin (8) of Q4355

From pin (3) of Q4354 to pin (7) of Q4355

From pin (4) of Q4354 to pin (6) of Q4355

From pin (5) of Q4354 to pin (5) of Q4355

Q4355 is the driver which causes current to flow to the drive coils, and the construction is, as shown in Fig. 2-2-15, a push-pull amplifier circuit. The drive coils are connected to output pins (12), (10) and (11) of Q4355. These outputs correspond to the Hall elements (Q4351, Q4352, and Q4353). Signals such as those shown in Fig. 2-2-14 (c) and (d) are output, and current flows, in order, in both directions to each drive coil according to the output of the Hall elements. As a result, the rotor is able to rotate smoothly and evenly.

The speed-control signals are input to pin (8) of Q4354. These signals are amplified and controlled within Q4354, and the size of the output current of the driver IC of Q4355 is thus regulated. As a result, the rotor operates in response to the speed-control signals, thereby rotating at a constant speed.

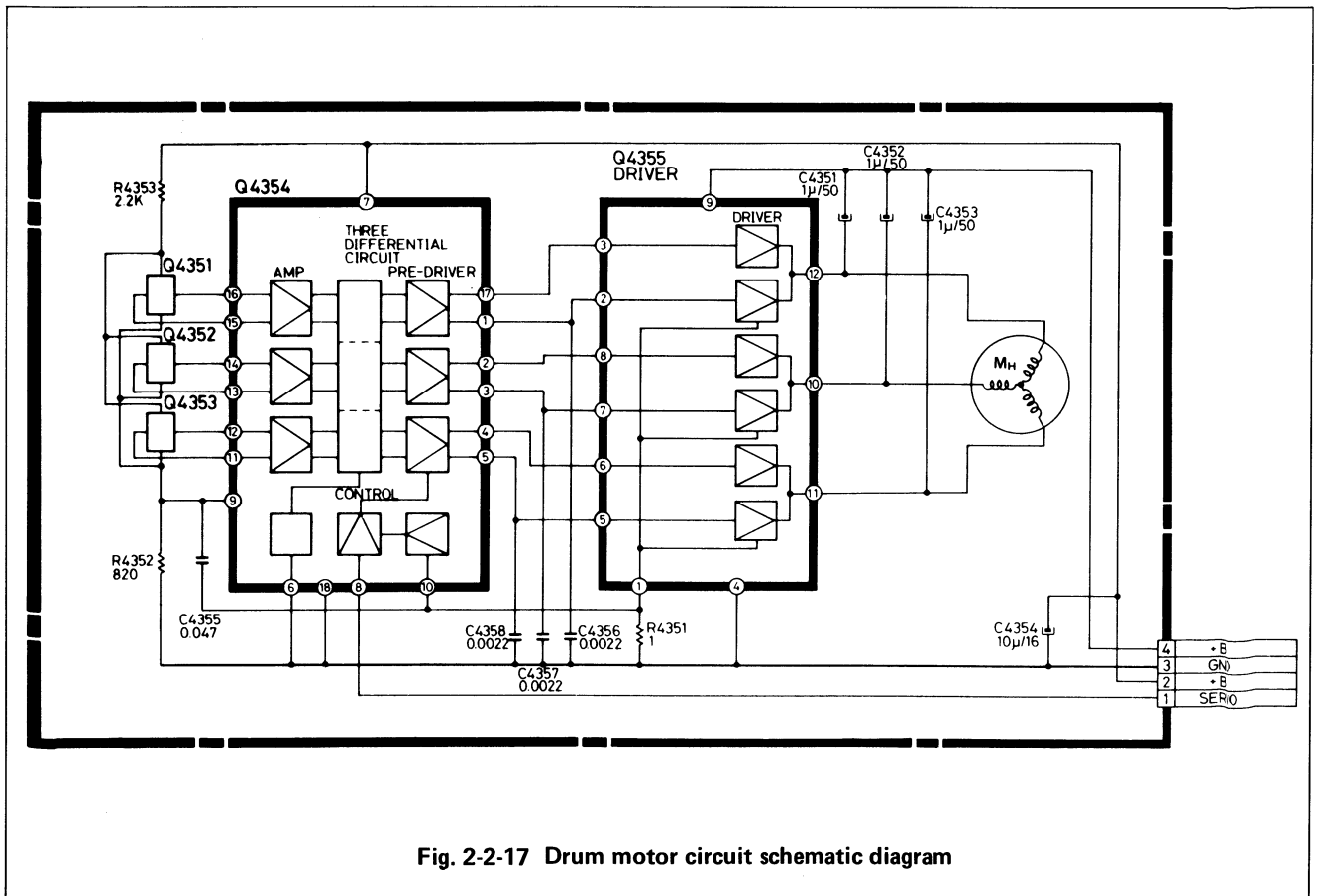


Fig. 2-2-17 Drum motor circuit schematic diagram

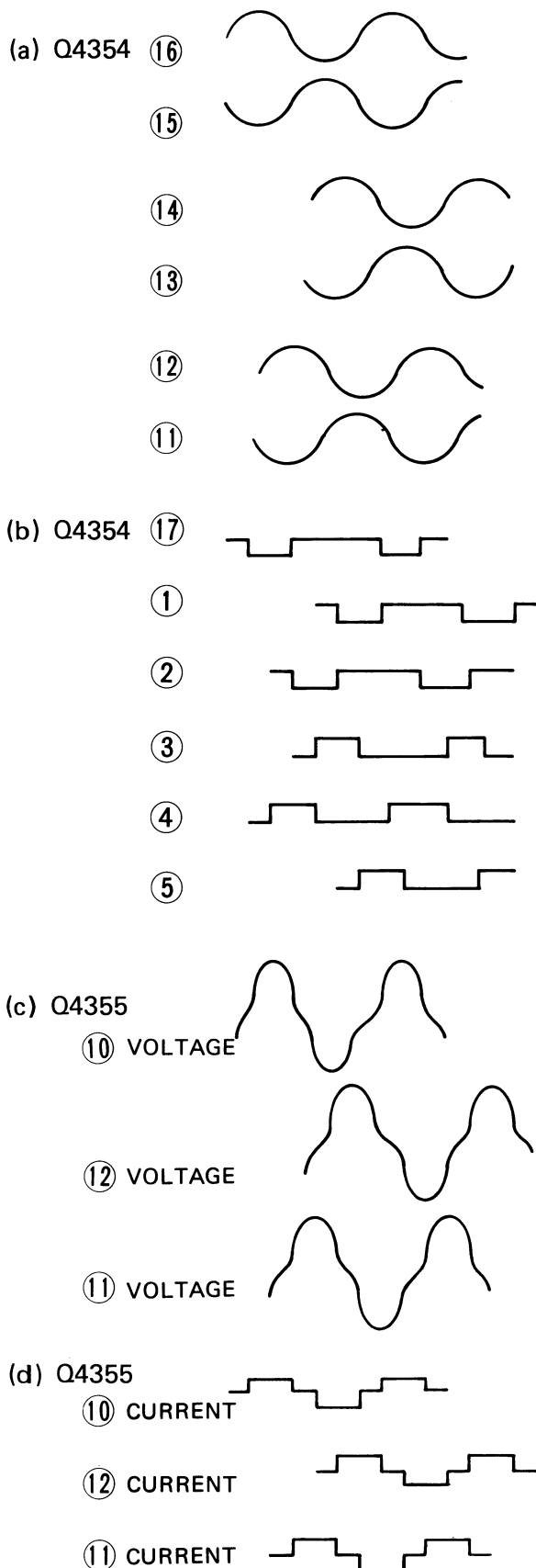
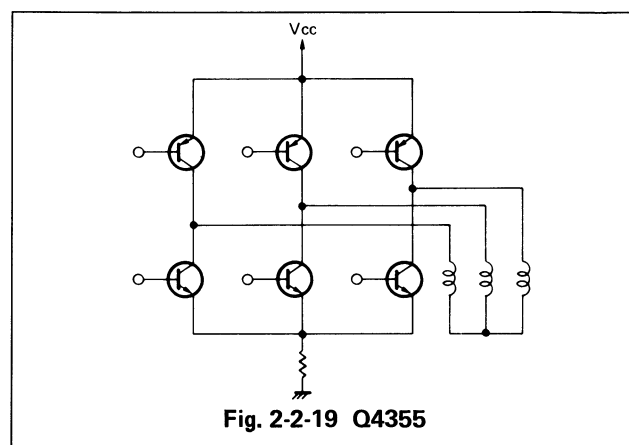


Fig. 2-2-18 Input and output signals timing chart



e. Fundamental operation of the capstan motor

The capstan motor circuit is mainly composed of a one-chip IC and three Hall elements.

The circuit diagram in Fig. 2-2-20 and the waveforms shown in Fig. 2-2-21 will be used for the explanation of the fundamental operation of the capstan motor drive circuit.

In the capstan motor, the three Hall elements (Q4301, Q4302, and Q4303) are arranged in locations corresponding to each of the three drive coils of the three phases. The output signals from these three Hall elements are, depending on the position of the magnets of the rotor, as shown in Fig. 2-2-21 (a). These signals are amplified, respectively, by Q4305, Q4306, and Q4307, and are then input to pins (2), (3), and (4) of Q4304. After being further amplified within Q4304, the signals are input to the three-differential circuit.

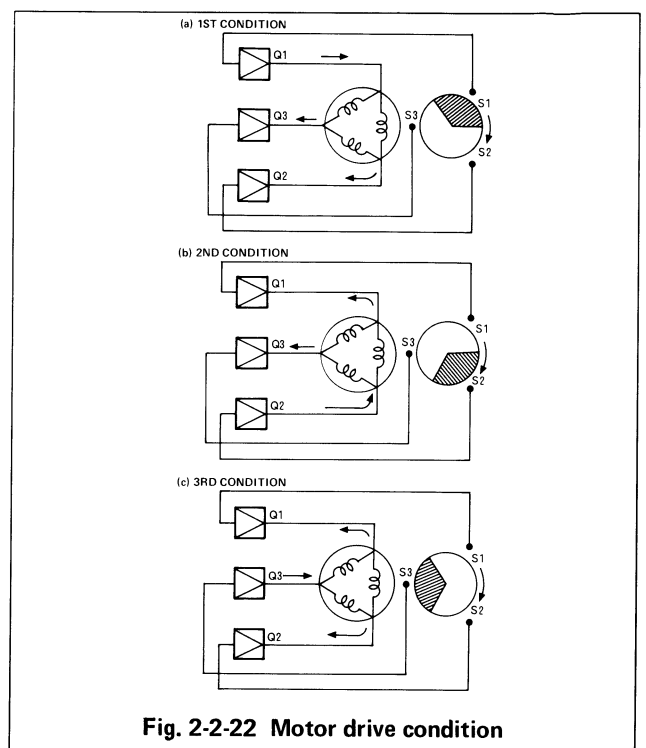
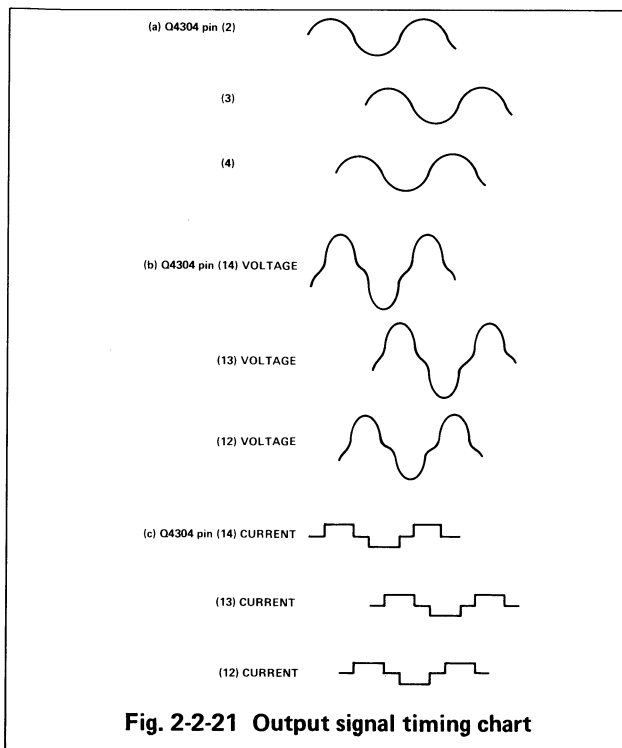
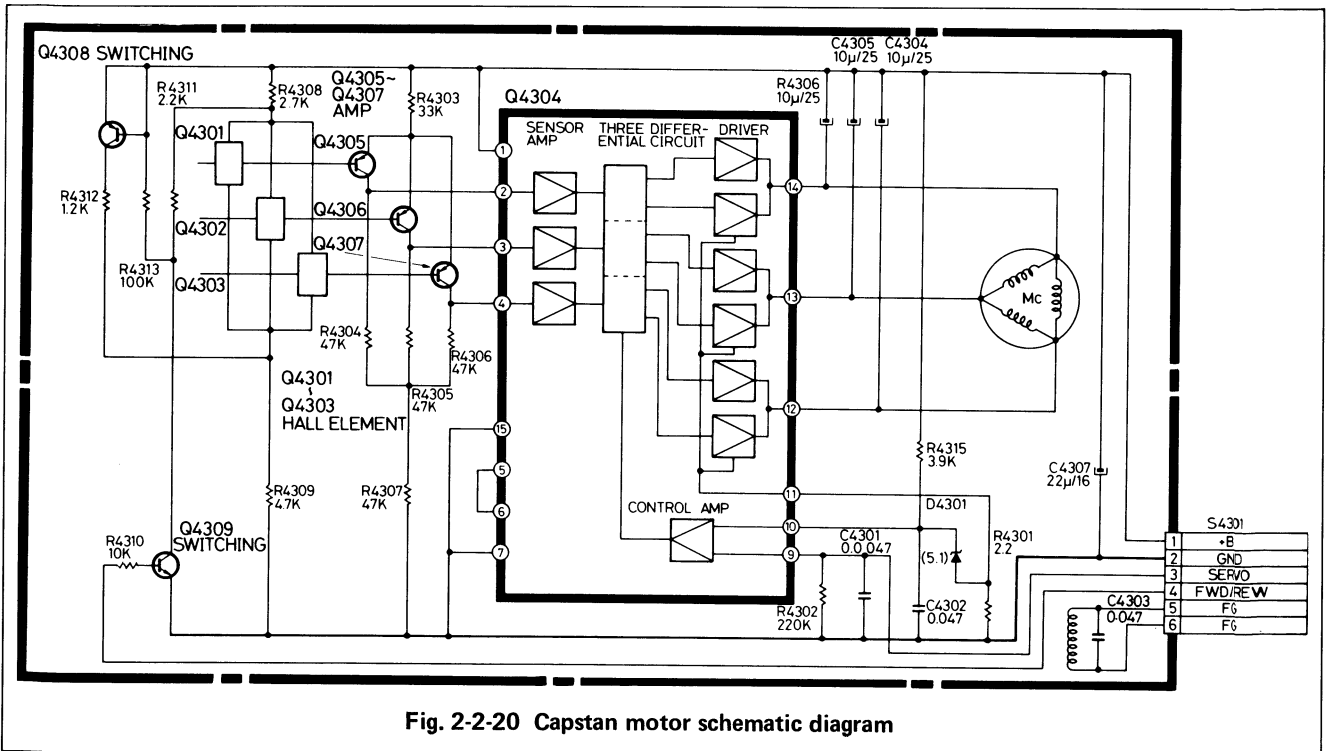
This three-differential circuit is the switching circuit by which the current flowing to the drive coils is electronically switched in order. Then, the output signal of the three-differential circuit is input to the three-system driver circuit in order to activate the driver circuit within Q4304. This driver circuit is, the same as the head motor, a push-pull amplifier circuit. The construction is shown in Fig. 2-2-19. Drive coils are connected to the driver circuit as the load. In other words, the signal shown in Fig. 2-2-21 (b) and (c) is output to pin (14), pin (13), and pin (12) of Q4304 according to the output of the Hall elements (Q4301, Q4302, and Q4303), and current flows in order to each coil in both directions. The operation of this circuit is the same as that for the head motor, and the current flow is shown in simplified form in Fig. 2-2-22. In other words, at the first condition (a), position detector S1 switches ON in accordance with the position of the rotor. Current then flows from Q1, passes through the drive coils, and flows to Q2 and Q3. As a result, the rotor rotates in the direction of the arrow in the (a) figure. Rotation continues, and, when S2 switches ON in accordance with the position of the rotor, the condition changes to the second condition (b). Next, current flows from Q2 to Q1 and Q3, passing through the drive coils, thereby causing the rotor to rotate further in the direction of the

arrow.

Next, when S3 switches ON, the third condition (c) occurs; rotation continues further, the condition returns to the first condition (a), and rotation becomes continuous.

The rotation speed of the capstan motor is detected by the speed generator, and, after the speed is compared with the standard reference signal by the servo circuit,

the output is input to pin (8) of Q4304. It is then control amplified by Q4304, and input by the three-differential circuit. This controls the base current of the driver circuit, and, as a result, the current flow to the drive coils which is the load of the driver circuit is increased or decreased, thus changing the rotation speed. As a result, the motor rotates at a constant speed in accordance with the speed-control signal.



IV. SYSTEM CONTROL CIRCUIT

A. SUMMARY

1. Main Functions of the System Control Circuit

- a. Logic control of the feather-touch operation buttons.
- b. Activation of the three solenoids (pinch roller, fast forward/rewind, and eject) and driving of the three motors (head, capstan, and reel), and also control of the various mechanisms.
- c. Detection through the various sensors, and, if an abnormality is discovered, automatic stopping of the VCR.
- d. Sending of a control signal to the video, audio, servo, and timer circuits.

2. Main Features of the System Control Circuit

- a. Uses N-channel, 4-bit, 1-chip microcomputer LM-6402A (Q3001) for the control IC.
- b. Includes input expander LC7800 (Q3002 and Q3003) for expansion of microcomputer system input; circuit construction has been simplified.
- c. Two-chip construction for various sensor circuits [tape and sensor circuit LA7011 (Q3005) and the other sensor circuit BA6135 (Q3006)].

3. New Circuitry

- a. Four-bit, 1-chip microcomputer LM6402A (Q3001) developed as a microcomputer for VCR control use, and the following functions added:
 - (1) Electronic eject function.
 - (2) In order to protect video heads and video tape, five-minute timer function for returning unit to the STOP mode after five minutes in the PAUSE mode.
- b. By including an input expander LC7800 (Q3002 and Q3003) for expansion of the microcomputer input, and converting the 31 input signals to four signals by using a 2-chip IC, the circuit construction of the microcomputer input circuit was simplified.
- c. The 1-chip BA6135 (Q3006) is used for the dew sensor, the reel base rotation sensor, and the control pulse detection circuit.

4. Modes of the VCR

The following modes are classified according to the input of the VCR operation buttons and controls:

- a. LOADING mode
- b. UNLOADING mode
- c. STOP mode
- d. REC mode
- e. PLAY mode
- f. PAUSE mode
- g. F FWD mode
- h. REW mode
- i. CASSETTE-UP mode

The conditions required for each mode are shown below. The mode will occur if and when any one set of the appropriate conditions exists.

a. LOADING mode

- (1) While power is being supplied, the cassette switch is ON [pin (16) of Q3003 is LOW] and the loading switch is OFF [pin (18) of Q3003 is HIGH].
- (2) While in the CASSETTE-UP mode, the cassette switch becomes ON [pin (16) of Q3003 is LOW].

b. UNLOADING mode

The EJECT button (SW3406) of the operation circuit board (SY-2) becomes ON, and, following that, the eject switch also becomes ON [pin (15) of Q3003 is LOW].

c. STOP mode

- (1) The STOP button (SW3402) of the operation circuit board (SY-2) becomes ON.
- (2) While in the REW mode, the REW STOP signal [pin (17) of Q3002] changes from HIGH to LOW (the counter RESET button is ON).
- (3) While the tape is moving in the forward direction, the rewind sensor signal [pin (11) of Q3002] becomes LOW (at the end of the tape).
- (4) While the tape is moving in the rewind direction, the forward sensor signal [pin (10) of Q3002] becomes LOW (at the end of the tape).
- (5) The dew sensor signal [pin (9) of Q3002] becomes LOW.
- (6) While the tape is moving, the reel base rotation sensor signal [pin (12) of Q3002] becomes LOW (when the reel base stops rotating).

d. REC mode

- (1) The timer recording signal is input [pin (16) of Q3002 is LOW].
- (2) While in any one of the STOP, PLAY, F FWD, or REW modes, the LOCK button (SW3409) and also the REC button (SW3407) become ON.
- (3) While in the PAUSE mode, the PAUSE button (SW3405) becomes ON.

e. PLAY mode

While in any one of the STOP, REC, F FWD, or REW modes, the PLAY button (SW3401) becomes ON.

f. PAUSE mode

While in the REC mode, the PAUSE button (SW3405) becomes ON.

g. F FWD mode

While in any one of the STOP, REC, PAUSE, or REW modes, the F FWD button (SW3404) becomes ON.

h. REW mode

While in any one of the STOP, REC, PAUSE, or F FWD modes, the REW button (SW3403) becomes ON.

i. CASSETTE-UP mode

The cassette SW becomes OFF [pin (16) of Q3003 becomes HIGH].

B. CIRCUIT EXPLANATION

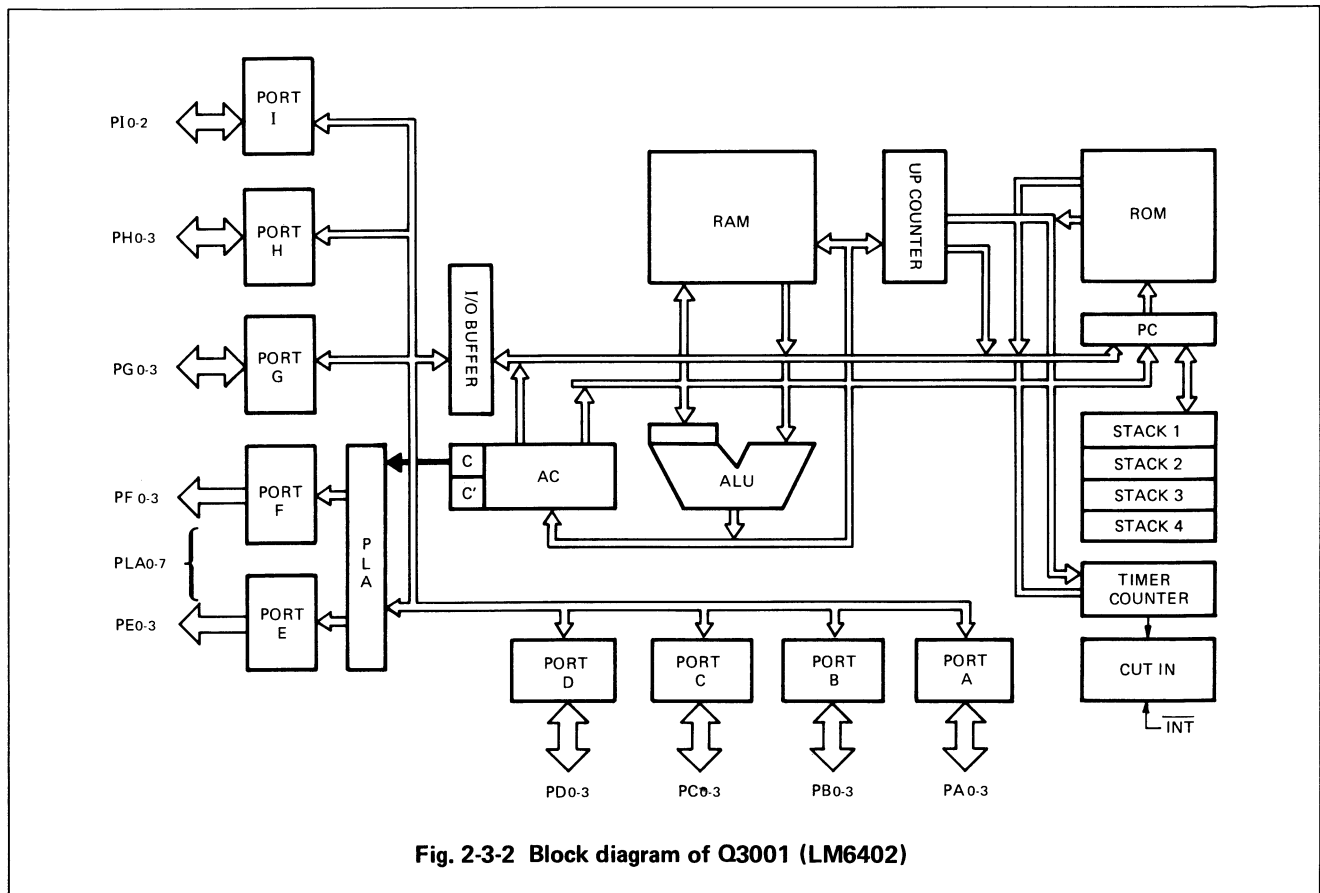
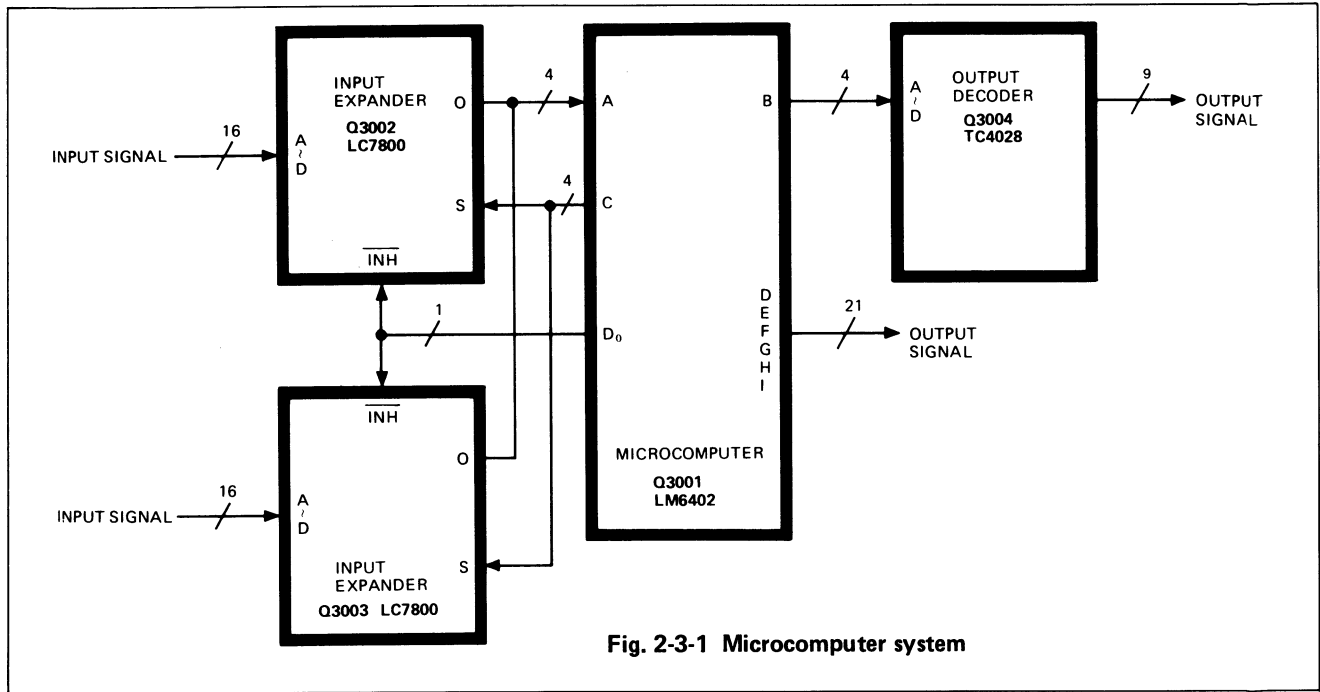
1. Microcomputer System

a. Hard construction

The microcomputer system is shown in Fig. 2-3-1. It

consists of the one-chip microcomputer LM6402 (Q3001), the input expander LC7800 (Q3002 and Q3003), and the output decoder TC4028 (Q3004).

The 31 input signals which are input to the two input expanders Q3002 and Q3003 are converted to four 0



output signals, and then input to the 4-bit, 1-chip micro-computer.

At the 4-bit microcomputer LM6402 (Q3001), treatment corresponding to the four input signals is accomplished, and signals are then output to ports B, D, E, F, G, and I. The roles of the various output ports of LM6402 are shown below:

- (1) Port A: 4-bit input data
- (2) Port B: mode signal expressed in binary code
- (3) Port C: input port selection signal
- (4) Port D: input expansion chip selection signal

The relationship between the port B output and the output mode is shown in Table 2-3-1, the block diagram

B _n	B ₁	B ₂	B ₃	Output mode
0	0	0	0	PAUSE
1	0	0	0	F FWD
0	1	0	0	REW
1	1	0	0	—
1	1	1	0	PLAY, REC
0	0	0	1	EJECT
1	0	0	1	UNLOADING

Table 2-3-1

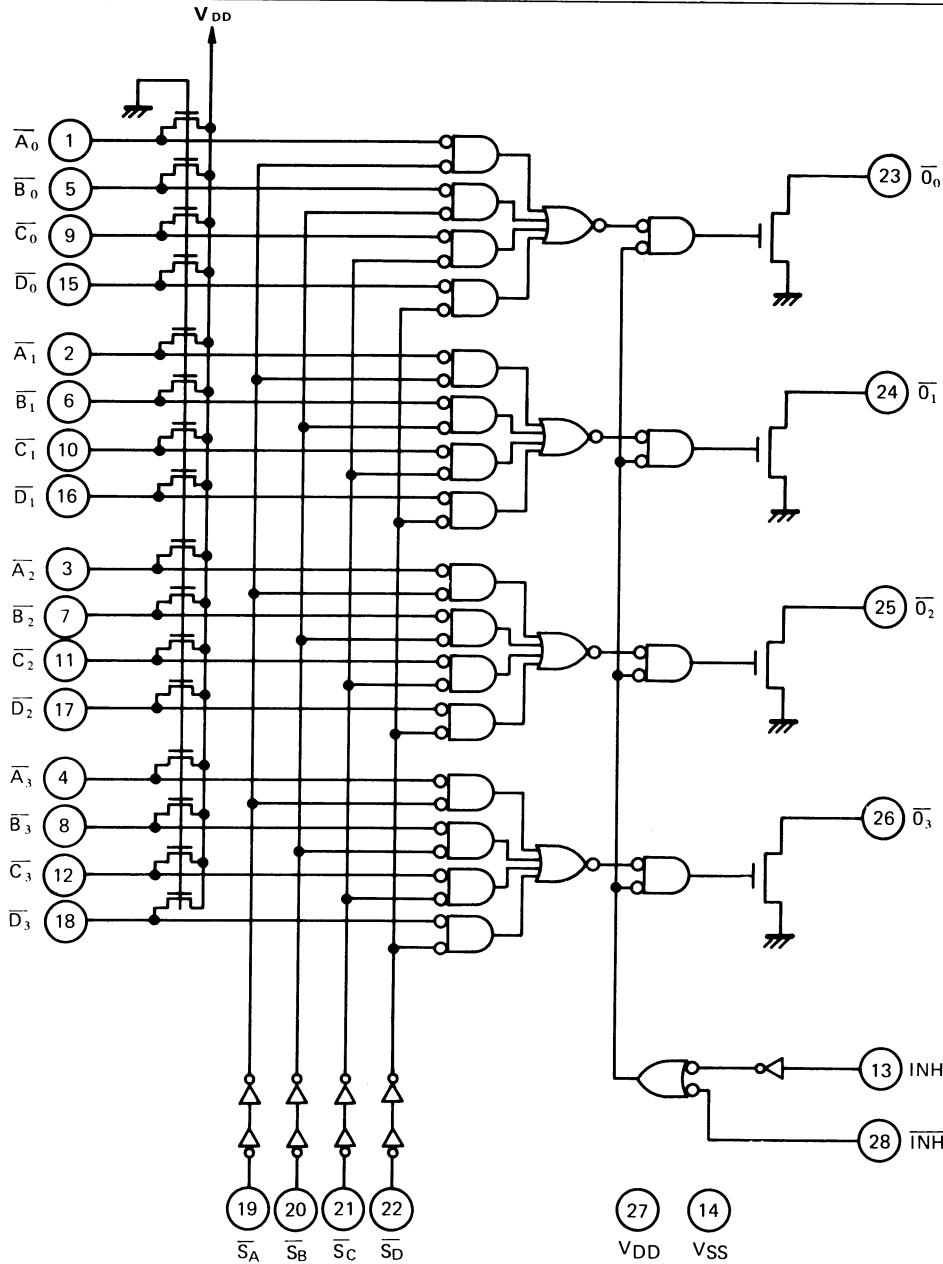


Fig. 2-3-3 Logic diagram for Q3003 (LC7800)

for LM6402 (Q3001) is shown in Fig. 2-3-2, and the logic diagram for LC7800 (Q3002 and Q3003) is shown in Fig. 2-3-3.

LM6402 is a 4-bit, 1-chip microcomputer with a 2k-byte ROM and a 512-bit RAM, and its input/output ports consist of input/output combination ports A, B, C, D, G, H, and I, and input-only ports E and F. The input expander LC7800 is the chip for converting the 16 input signals A0 ~ D0, A1 ~ D1, A2 ~ D2, A3 ~ D3 into the 4-bit signals 00, 01, 02, and 03.

b. Input signals to the microcomputer

The input signals to the input expander LC7800 (Q3002 and Q3003) are shown in Table 2-3-2.

An explanation of each of the input signals is given below:

(1) Auto play switch

If this switch is ON [pin (1) of Q3002 is LOW] when either the end of the tape is reached or the tape counter reaches 9999 (if the memory switch is ON) while in the REW mode, the mode automatically will change to PLAY.

(2) Auto rewind switch

If the end of the tape is reached while in any one of the REC, PLAY, or F FWD modes, the mode will automatically change to REW.

(3) Erasure-prevention switch

If a cassette which is inserted has had its erasure-prevention tab removed, this switch will become OFF [pin (5) of Q3002 becomes HIGH].

(4) Inhibit switch

If this switch becomes ON [pin (6) of Q3002 becomes LOW], no input will be allowed from the REC, PLAY, or any of the other operation buttons (the normal state is HIGH).

(5) Lock selection switch

If this switch is ON [pin (7) of Q3002 is LOW], direct input from the REC button is possible. If this switch is OFF [pin (7) of Q3002 is HIGH], the mode will not change to REC unless the REC button is pressed within one second after pressing the LOCK button.

(6) Dew sensor

If dew forms, pin (9) of Q3002 will become LOW.

(7) Forward sensor

When the end of the tape is reached in the forward direction, pin (10) of Q3002 will become LOW.

(8) Rewind sensor

When the end of the tape is reached in the reverse direction, pin (11) of Q3002 will become LOW.

Input Ports	Input Pin No	Q3002 (LC7800)	Q3003 (LC7800)
A0	1	Auto play switch	LOCK button
A1	2	Auto rewind switch	_____
A2	3	_____	REC button
A3	4	_____	EJECT button
B0	5	Erasure prevention switch	PAUSE button
B1	6	Inhibit switch	_____
B2	7	Lock selection switch	_____
B3	8	_____	_____
C0	9	DEW SENSOR	F FWD button
C1	10	FWD SENSOR	REW button
C2	11	REW SENSOR	STOP button
C3	12	REEL SENSOR	PLAY button
D0	15	CONTROL SIGNAL	EJECT button
D1	16	TIMER REC SIGNAL	Cassette switch
D2	17	REW STOP SIGNAL	_____
D3	18	_____	Loading switch

Table 2-3-2 Input signals to the microcomputer

Port	Pin no.	Output signal
D	D0 (8)	Input expander chip selection
	D1 (9)	Pinch roller solenoid activation
	D2 (10)	Fast forward/rewind solenoid activation
	D3 (11)	
E	E0 (12)	Video mute
	E1 (13)	Audio mute
	E2 (14)	REC $\overline{EE}$
	E3 (15)	STILL mode
F	F0 (16)	PAUSE LED
	F1 (17)	REC LED
	F2 (18)	
	F3 (19)	PLAY mode
G	G0 (22)	
	G1 (23)	REC mode
	G2 (24)	
	G3 (25)	
H	H0 (26)	HEAD MOTOR (MH)
	H1 (27)	CAPSTAN MOTOR (MC)
	H2 (28)	LOADING mode
	H3 (29)	REC PAUSE
I	I0 (30)	REEL MOTOR
	I1 (31)	Pinch roller solenoid hold
	I2 (32)	Fast forward/rewind solenoid hold
B	B0	
	B1 B2	Binary code output to the decoder (TC4028)
	B3	

Table 2-3-3 Output signals of Q3001

Port	Pin no.	Output signal
1	14	F FWD mode
2	2	REW mode
7	4	EJECT mode
8	9	UNLOADING mode

Table 2-3-4 Output signals of Q3004

(9) Reel sensor

If the rotation of the take-up reel base stops, pin (12) of Q3002 will become LOW.

(10) Control signal

If the control pulse from the tape ceases to be played back, a HIGH signal will be input to pin (15) of Q3002, and a video and audio mute signal will be output.

(11) Timer recording signal

During timer recording, a LOW signal will be input to pin (16) of Q3002.

(12) Rewind stop signal

If the number readout of the tape counter reaches 9999 while the memory switch is ON, a LOW signal will be input to pin (17) of Q3002. If this signal changes from HIGH to LOW during the REW mode, the mode of the VCR will change to STOP.

(13) Cassette switch

When a cassette is loaded, a LOW signal is input to pin (16) of Q3003.

(14) Loading switch

At the conclusion of loading, pin (18) of Q3003 becomes LOW.

c. Microcomputer output signals

The output signals of LM6402 (Q3001) and TC4028 (Q3004) are shown in Table 2-3-3 and Table 2-3-4, respectively.

The mode signals determined by the video muting, audio muting, and pinch-roller solenoid hold, and fast forward/rewind solenoid hold signals, and also by the binary signal of port B, are output at "high active".

d. Modes and output signals

The relationships of the output signals to the operation of the microcomputers in the principal modes are explained below:

(1) LOADING mode (Refer to Fig. 2-3-4.)

When a cassette is loaded, the cassette switch becomes ON, and the signal is transmitted to pin (16) of Q3003. The signal enters pin (34) of Q3001 from pin (24) of Q3003, and pin (26) of Q3001 becomes LOW. The signal of pin (26) passes through pins (5), (6) → (4) of Q3007, is transmitted to pin (1) of S3017, and then the MH-ON signal which causes the head motor to rotate is supplied to the servo circuit.

In addition, pin (28) and pin (30) of Q3001 become LOW, the signal passes through pins (6) → (9) → (5) → (10), (2) → (13) → (3) → (12) of Q3009, and then through Q3017, Q3018, Q3019 → Q3020, and a voltage of approximately 9 V is applied to the plus (+) terminal of the reel motor. The minus (-) terminal of the reel motor is earthed through Q3023, and the reel motor starts rotating in the forward direction.

(2) STOP mode (Refer to Fig. 2-3-5.)

When the STOP button is pressed, the STOP signal is input to pin (11) of Q3003. The signal enters pin (35) of Q3001 from pin (25) of Q3003, and pin (14) of Q3001 becomes LOW. The signal of pin (14) passes through pins (3) → (4) of Q3008, and the REC EE signal is supplied to the video circuit so that the mode changes to REC EE. By using this signal, the video circuit projects the EE monitor picture on the television screen.

(3) REC mode (Refer to Fig. 2-3-6.)

When the LOCK button is pressed, the LOCK signal passes through pins (1) → (23) of Q3003, and is input to pin (33) of Q3001. If the REC button is pressed within one second of this, the REC signal will pass through pins (3) → (25) of Q3003, be input to pin (35) of Q3001, and the mode will change to REC.

When the mode changes to REC:

- (a) Pin (14) of Q3001 becomes LOW; this signal is reversed by pins (3) → (4) of Q3008, and the REC EE signal is supplied to the audio/video circuit.
- (b) Pin (17) of Q3001 becomes LOW; and the LED which is connected to pin (7) of S3008 illuminates.
- (c) Pin (23) of Q3001 becomes LOW; this signal is reversed by pins (1) → (2) of Q3008, and REC and PAUSE signals are supplied to the servo circuit and the video circuit.
- (d) Pin (26) of Q3001 becomes LOW; this signal is inverted through pins (11) → (10) of Q3008, and the MH-ON signal which causes the head motor to rotate is supplied to pin (1) of S3017.
- (e) Pin (27) of Q3001 becomes LOW; this signal is inverted through pins (13) → (12) of Q3008, and the MC-STD signal which causes the capstan motor to

rotate is supplied to pin (2) of S3017.

- (f) Pin (29) of Q3001 becomes LOW; this signal is inverted through pins (1), (2) → (3) of Q3007, and the REC PAUSE signal which controls the pause for timer recording is supplied to pin (2) of S3004.
- (g) Pin (30) of Q3001 becomes LOW; this signal passes through pins (5) → (10) → (3) → (12) of Q3009, then through Q3017, Q3019 → Q3020, and the DC voltage necessary for approximately 1,000 rpm is applied to the plus (+) terminal of the reel motor. The minus (-) terminal is earthed through Q3023, and the reel motor starts rotating in the forward direction.
- (h) Pin (31) of Q3001 becomes HIGH; this signal passes through pins (23) → (22) of Q3029, is amplified by Q3024, and then activates the pinch roller solenoid. After the pinch roller solenoid has been activated, the signal that passes through pin (22) of Q3029 is amplified by Q3025 and maintains the solenoid in the activated condition.

(4) PLAY mode (Refer to Fig. 2-3-7.)

When the PLAY button is pressed, the PLAY signal passes through pins (12) → (26) of Q3003, is input to pin (36) of Q3001, and the mode changes to PLAY.

When the mode changes to PLAY:

- (a) Pin (12) and pin (13) of Q3001 become HIGH, and the VIDEO MUTE signal and the AUDIO MUTE signal are supplied to the video circuit and the audio circuit, respectively.
- (b) Pin (19) of Q3001 becomes LOW and the PLAY LED, which is connected to pin (5) of S3008 to illuminate.
- (c) Pin (26) of Q3001 becomes HIGH; this signal is inverted through pins (11) → (10) of Q3008, and the MH-ON signal is supplied to pin (1) of S3017.
- (d) Pin (27) of Q3001 becomes LOW; this signal is inverted through pins (13) → (12) of Q3008, and the MC-ON signal is supplied to pin (2) of S3017.
- (e) Pin (30) of Q3001 becomes LOW; this signal passes through pins (5) → (10) → (3) → (12) of Q3009 → Q3017, Q3019, Q3020, and the DC voltage necessary for approximately 1,000 rpm is applied to the plus (+) terminal of the reel motor. The minus (-) terminal is earthed through Q3023, and the reel motor starts rotating in the forward direction.
- (f) Pin (31) of Q3001 becomes HIGH; this signal passes through pins (23) → (22) of Q3029, is amplified by Q3024, and then activates the pinch roller solenoid. After the pinch roller solenoid has been activated, the signal that passes through pin (22) of Q3029 is amplified by Q3025 and maintains the solenoid in the activated condition.

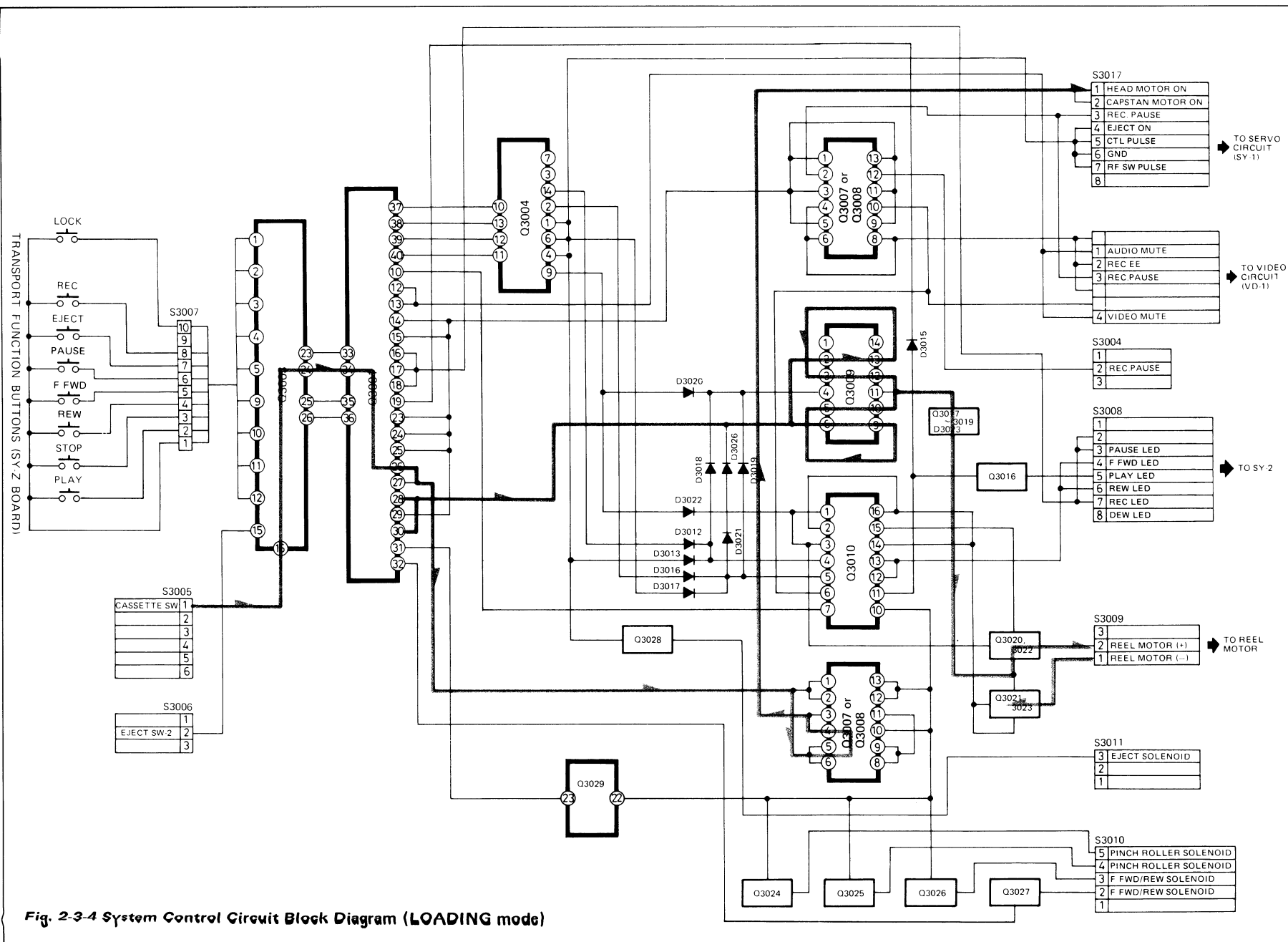


Fig. 2-3-4 System Control Circuit Block Diagram (LOADING mode)

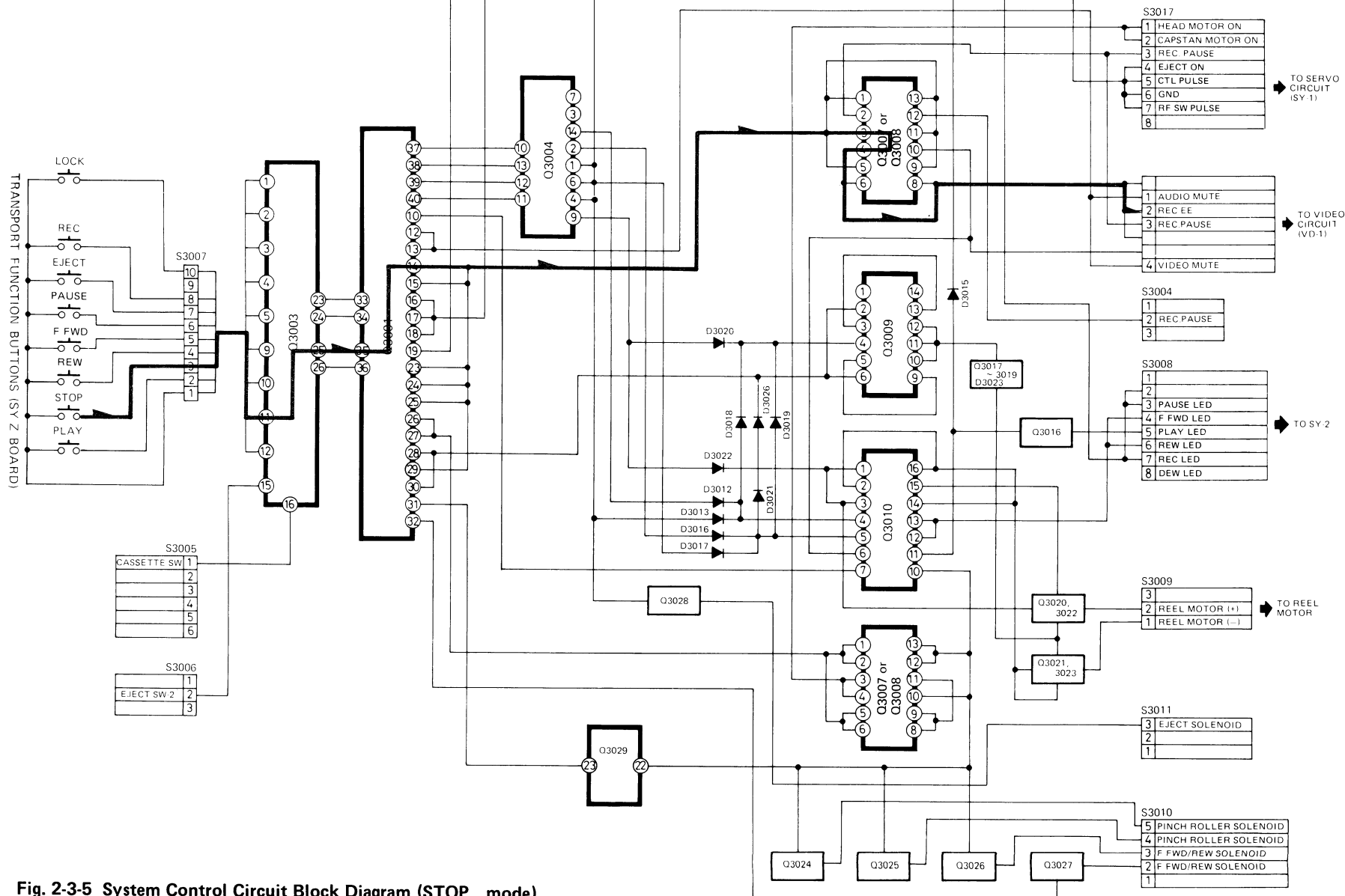


Fig. 2-3-5 System Control Circuit Block Diagram (STOP mode)

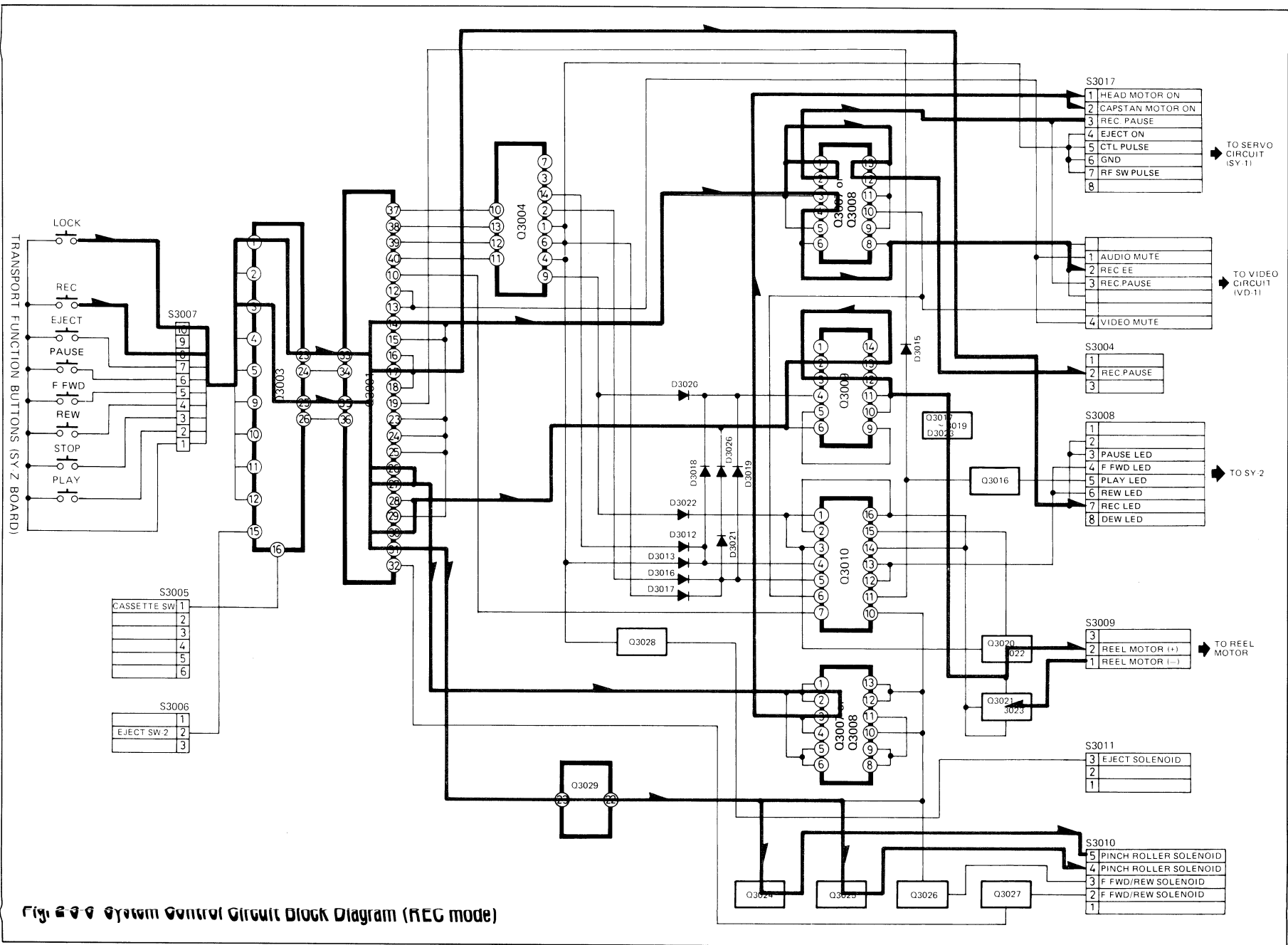


Fig. 2-2-2 System Control Circuit Block Diagram (REC mode)

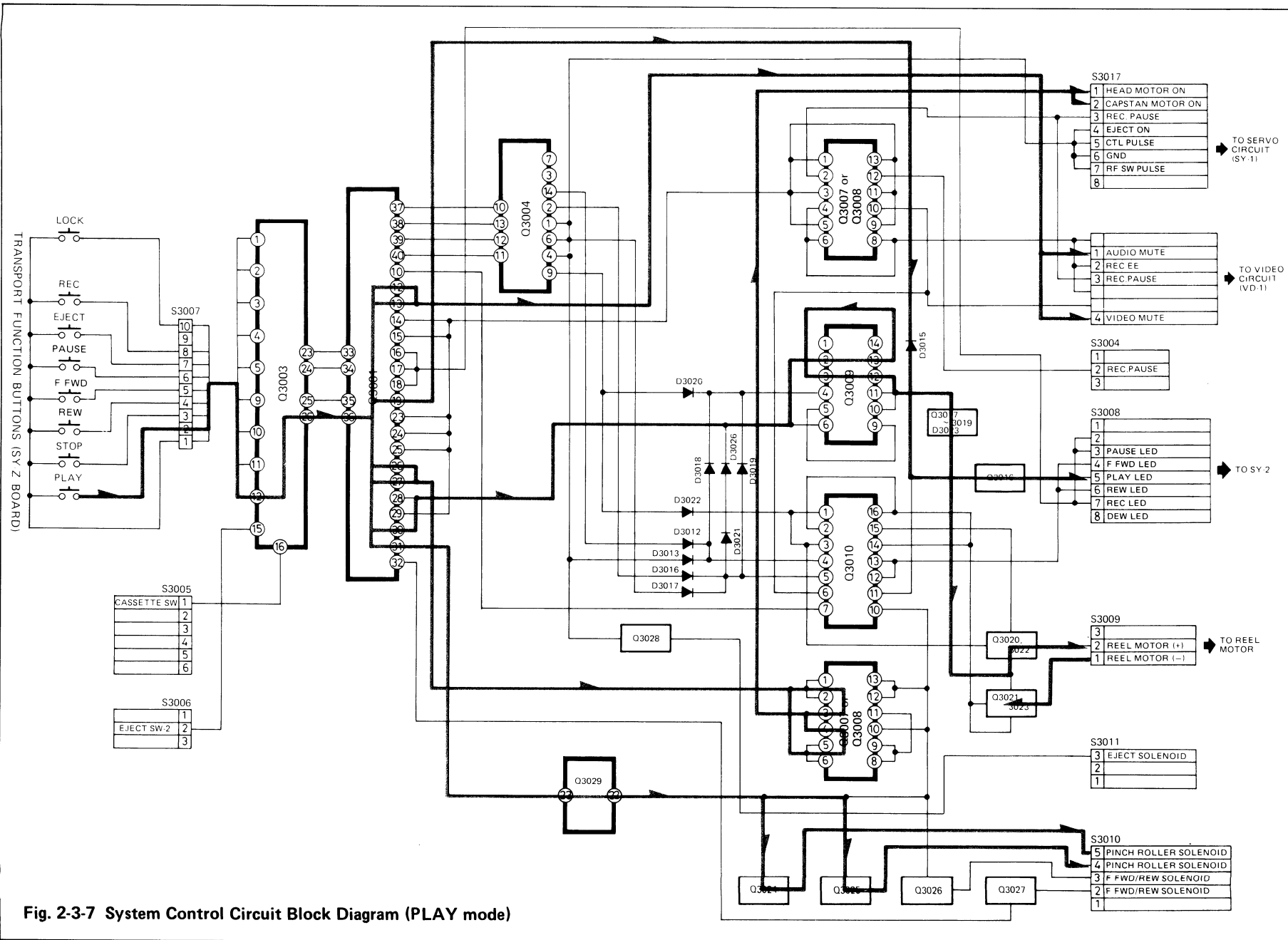


Fig. 2-3-7 System Control Circuit Block Diagram (PLAY mode)

(5) PAUSE mode (Refer to Fig. 2-3-8.)

If the PAUSE button is pressed during the REC mode, the mode will change to PAUSE. The PAUSE mode signal is input to pins (1) LOCK, (3) REC, and (5) PAUSE of Q3003, and the output of pin (23) and pin (26) of Q3003 is input to pin (33) and pin (36) of Q3001, respectively. When the mode changes to PAUSE:

- (a) Pin (16) of Q3001 alternates between LOW and HIGH and this causes the PAUSE LED, which is connected to pin (3) of S3008, to blink on and off.
- (b) Pin (17) of Q3001 becomes LOW, and the REC LED, which is connected to pin (7) of S3008, illuminates.
- (c) Pin (23) of Q3001 becomes LOW; this signal is inverted by pins (1) → (2) of Q3008, and the REC and PAUSE signals are supplied to the servo circuit and the video circuit.
- (d) Pin (26) of Q3001 becomes LOW; this signal is inverted through pins (5), (6) → (4) of Q3007, and the MH-ON signal is supplied to pin (1) of S3017.
- (e) Pin (27) of Q3001 becomes LOW; this signal is inverted through pins (1), (2) → (3) of Q3007 and the MC-ON signal is supplied to pin (2) of S3017.
- (f) Pin (30) of Q3001 becomes LOW; this signal passes through pins (2) → (13) → (3) → (12) of Q3009 → Q3017, Q3019, and Q3020, and the DC voltage is applied to the plus (+) terminal of the reel motor.

(6) F FWD mode (Refer to Fig. 2-3-9.)

If the F FWD button is pressed, the F FWD signal passes through pins (9) → (23) of Q3003, is input to pin (33) of Q3001, and the mode will change to F FWD.

When the mode changes to F FWD:

- (a) Pin (10) of Q3001 becomes LOW; this signal is inverted by pins (7) → (10) of Q3010, switches Q3026 ON, and activates the F FWD/REW solenoid. In addition, pin (32) of Q3001 becomes HIGH; this switches Q3027 ON, and maintains the fast forward/rewind solenoid in the activated condition.
- (b) Pin (14) of Q3001 becomes LOW; this signal is inverted by pins (3) → (4) of Q3008, and the REC EE signal is supplied to the audio circuit and the video circuit.
- (c) Pin (26) of Q3001 becomes LOW; this signal is inverted through pins (5), (6) → (4) of Q3007, and the MH-ON signal is supplied to pin (1) of S3017.
- (d) Pin (30) of Q3001 becomes LOW; this signal passes through pins (2) → (13) → (3) → (12) of Q3009 → Q3017, Q3018 [regarding Q3018, pin (14) of Q3004 becomes HIGH, and Q3018 switches ON], Q3019, and Q3020, and the DC voltage necessary for approximately 4,000 rpm is applied to the plus (+) terminal of the reel motor. The minus (-) terminal is earthed through Q3023, and the reel motor starts rotating in the forward direction.

- (e) Pin (14) of Q3004 becomes HIGH; this signal is inverted through D3012 → pins (4) → (13) of Q3010, and causes the F FWD LED, which is connected to pin (4) of S3008, to illuminate.

(7) REW mode (Refer to Fig. 2-3-10.)

If the REW button is pressed, the REW signal passes through pins (10) → (24) of Q3003, is input to pin (34) of Q3001, and the mode changes to REW.

When the mode changes to REW:

- (a) Pin (10) of Q3001 becomes LOW; this signal is inverted by pins (7) → (10) of Q3010, switches Q3026 ON, and activates the fast forward/rewind solenoid. In addition, pin (32) of Q3001 becomes HIGH; this switches Q3027 ON, and maintains the fast forward/rewind solenoid in the activated condition.
- (b) Pin (14) of Q3001 becomes LOW; this signal is inverted by pins (3) → (4) of Q3008, and the REC EE signal is supplied to the audio circuit and the video circuit.
- (c) Pin (26) of Q3001 becomes LOW; this signal is inverted through pins (5), (6) → (4) of Q3007, and the MH-ON signal is supplied to pin (1) of S3017.
- (d) Pin (30) of Q3001 becomes LOW; this signal passes through pins (2) → (13) → (3) → (12) of Q3009 → Q3017, Q3018 [regarding Q3018, pin (2) of Q3004 becomes HIGH, and Q3018 switches ON], Q3019, and Q3021, and the DC voltage necessary for approximately 4,000 rpm is applied to the minus (-) terminal of the reel motor. The plus (+) terminal is earthed through Q3022, and the reel motor starts rotating in the reverse direction.
- (e) Pin (2) of Q3004 becomes HIGH; this signal is inverted through D3016 → pins (5) → (12) of Q3010, and causes the REW LED, which is connected to pin (6) of S3008, to illuminate.

(8) UNLOADING mode (Refer to Fig. 2-3-11.)

If the EJECT button is pressed, the EJECT signal will pass through pins (4) → (23) of Q3003, and be input to pin (33) of Q3001.

- (a) Pin (26) of Q3001 becomes LOW; this signal is inverted through pins (5), (6) → (4) of Q3007, and the MH-ON signal is supplied to pin (1) of S3017.
- (b) Pin (4) of Q3004 becomes HIGH, this switches Q3028 ON, and maintains the EJECT solenoid in the activated condition.
- (c) Pin (27) of Q3001 becomes LOW; this signal is inverted through pins (1), (2) → (3) of Q3007, and the MC-ON signal is supplied to pin (2) of S3017. When the capstan motor starts to rotate, the eject lever becomes locked, and the eject switch becomes ON.

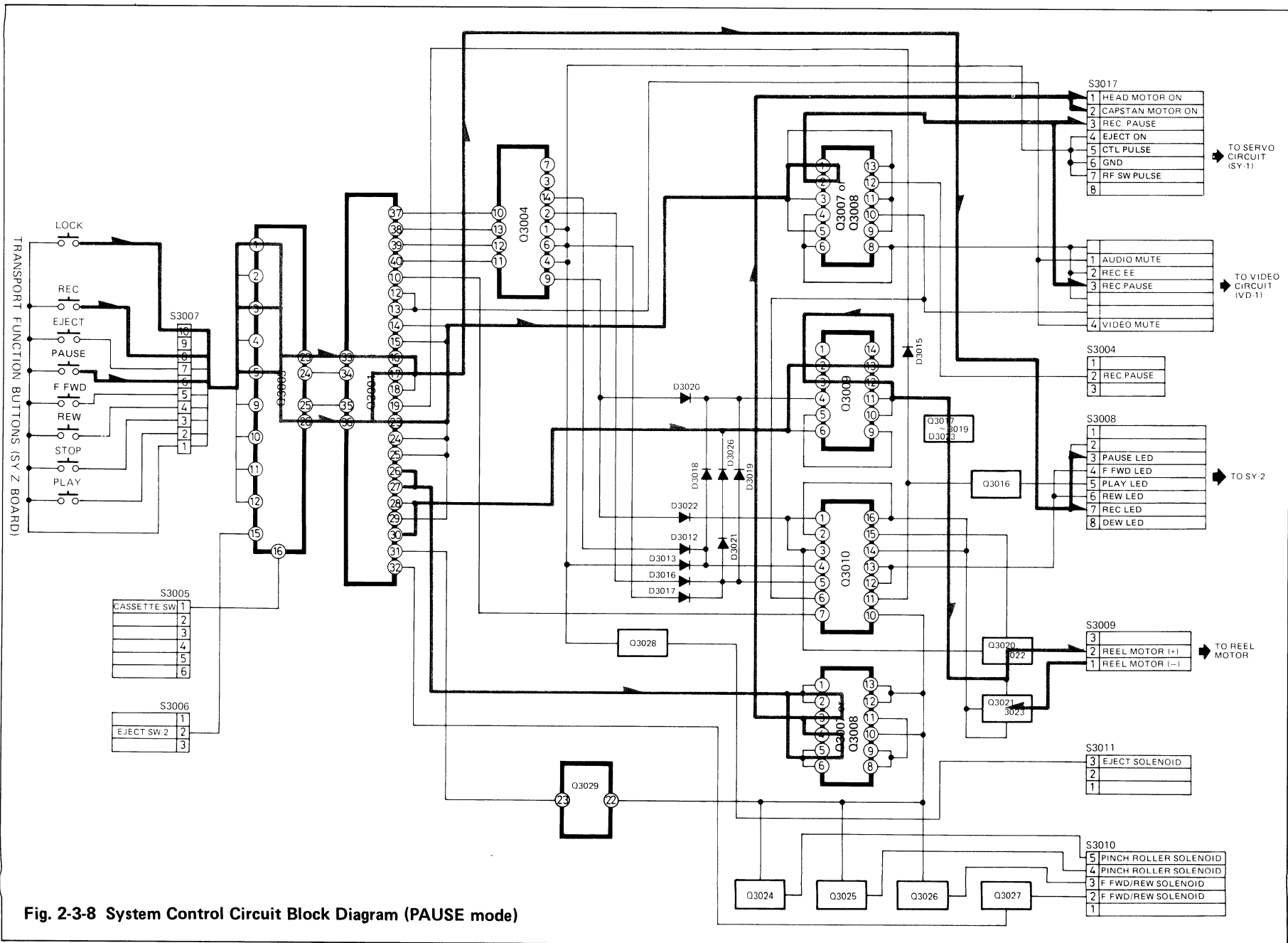


Fig. 2-3-8 System Control Circuit Block Diagram (PAUSE mode)

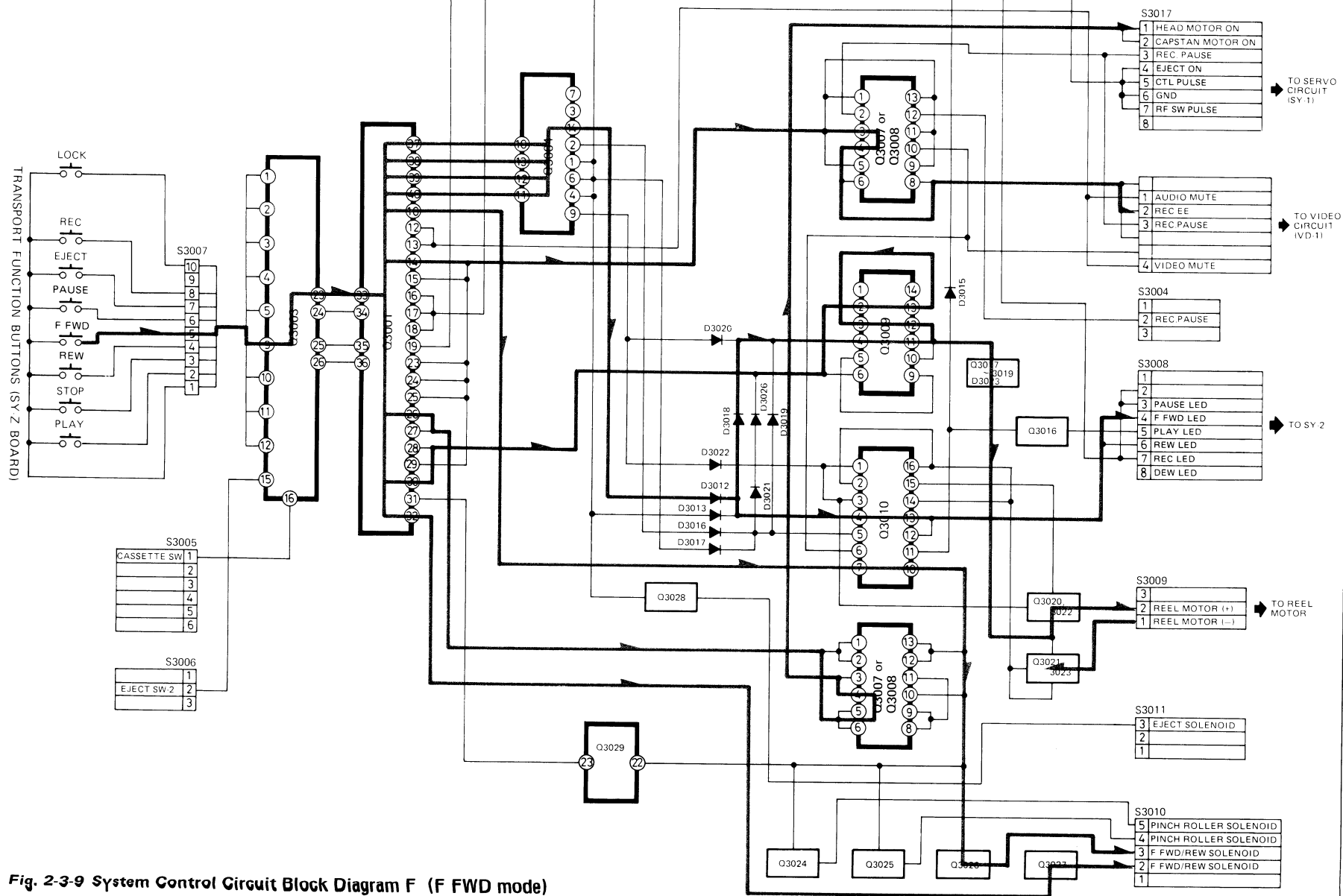


Fig. 2-3-9 System Control Circuit Block Diagram F (F FWD mode)

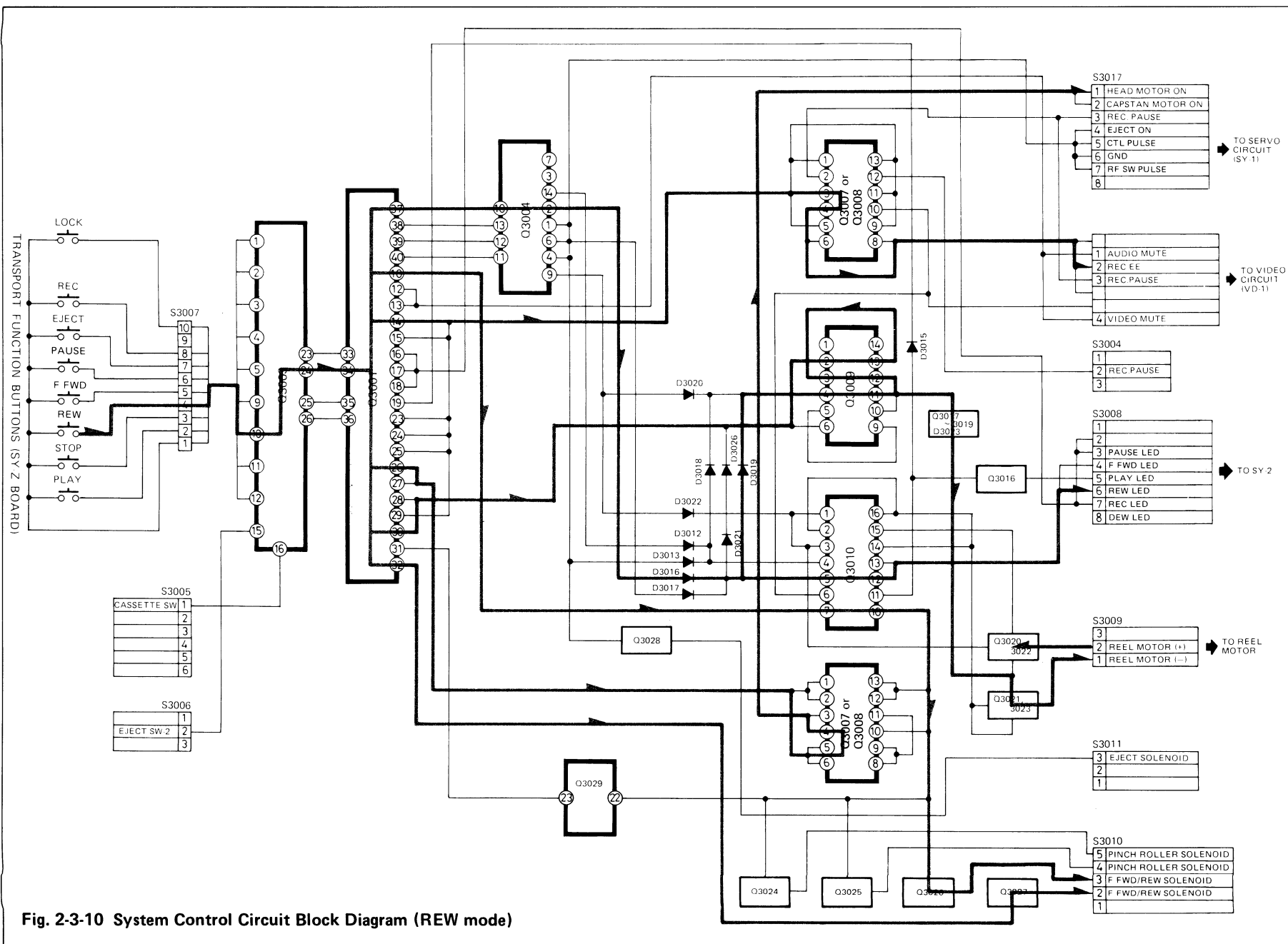
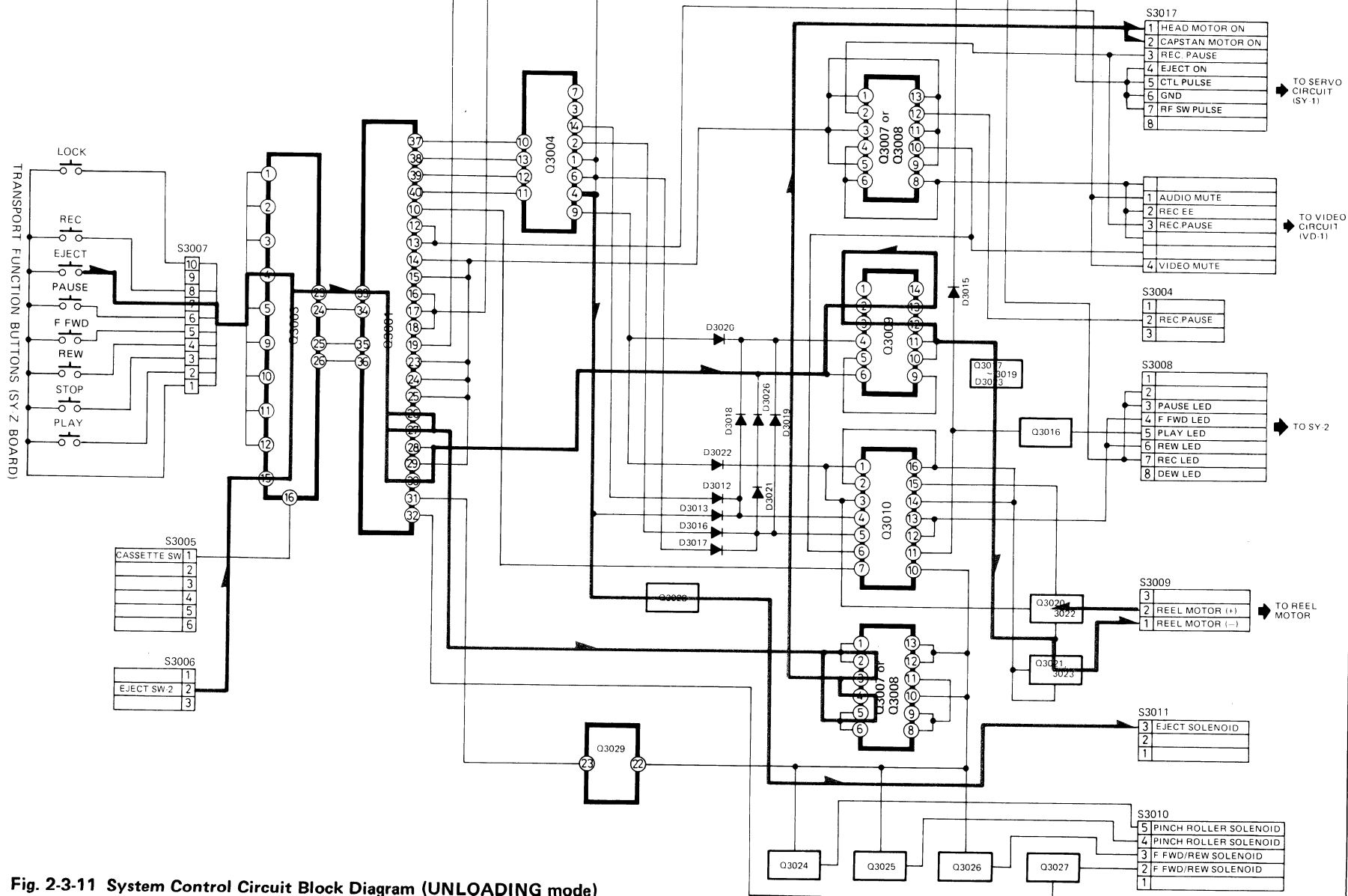


Fig. 2-3-10 System Control Circuit Block Diagram (REW mode)



Output signal	Head motor	Capstan motor	Reel motor	Pinch roller solenoid	Fast forward/ rewind solenoid	Eject solenoid	LOADING mode	UNLOADING mode	REC-PAUSE mode	PLAY mode
Output pin no.	Q3001 ②⑥	Q3001 ②⑦	Q3001 ③⑩	Q3001 ③①	Q3001 ③②	Q3004 ④	Q3001 ②⑧	Q3004 ④⑨	Q3001 ②⑨	Q3004 ④⑦
STOP mode										
REC, PLAY modes	1	1	A	B					1 *	1
PAUSE mode	1		1	1						
F FWD mode	1		C		D					
REW mode	1		C		D					
LOADING mode	1		A				1			
UNLOADING mode	1		A					1		
CASSETTE UP mode										
EJECT mode	1	1				1				
Remarks									REC mode only	

- A: After 0.1 second: "1"
(Remains in previous condition for 0.1 second)
- B: After 0.2 second: "1"
(Remains in previous condition for 0.2 second)
- C: After 0.7 second: "1"

- D: After 0.5 second: "1"
- E: After 0.2 second: "1"

The head motor, capstan motor, reel motor, **LOADING** mode, and REC PAUSE signals are all output as **negative** logic.

Table 2-3-5

Output signal	Capstan brake	REC mode	PLAY mode	PAUSE mode	F FWD mode	REW mode	PAUSE LED	REC LED	Video mute	Audio mute	REC EE mode
Output pin no.	②② Q3001	②③ Q3001	①⑨ Q3001	③ Q3004	①④ Q3004	② Q3004	①⑥ Q3001	①⑦ Q3001	①② Q3001	①③ Q3001	①④ Q3001
EJECT mode											
STOP mode											1
REC mode		1						1*			
PLAY mode			1						1*	A	B
PAUSE mode		1		1			1*	1*			1
F FWD mode					1						1
REW mode						1					1
Remarks							Flashing at 1-second intervals	Flashing at 1-second intervals (LOCK switch "0")	If control signal is "1","1","1"		

A: Audio mute

- (1) 2 seconds after power supply begins: "1"
- (2) 0.5 second after change from REC mode to PLAY mode and REC EE changes from "1" to "0": "1"
- (3) If during PLAY mode, REC EE is "0", control signal is "1": "1"

B: REC EE mode

- (1) 3 seconds after the beginning of forward movement and the LOADING mode when the mode has changed from STOP, F FWD, or REW to PLAY: "1"
- (2) During LOADING mode
Except for the PAUSE mode, the FF mode, the REW mode, video muting, and audio muting, all output is done as negative logic.

Table 2-3-6

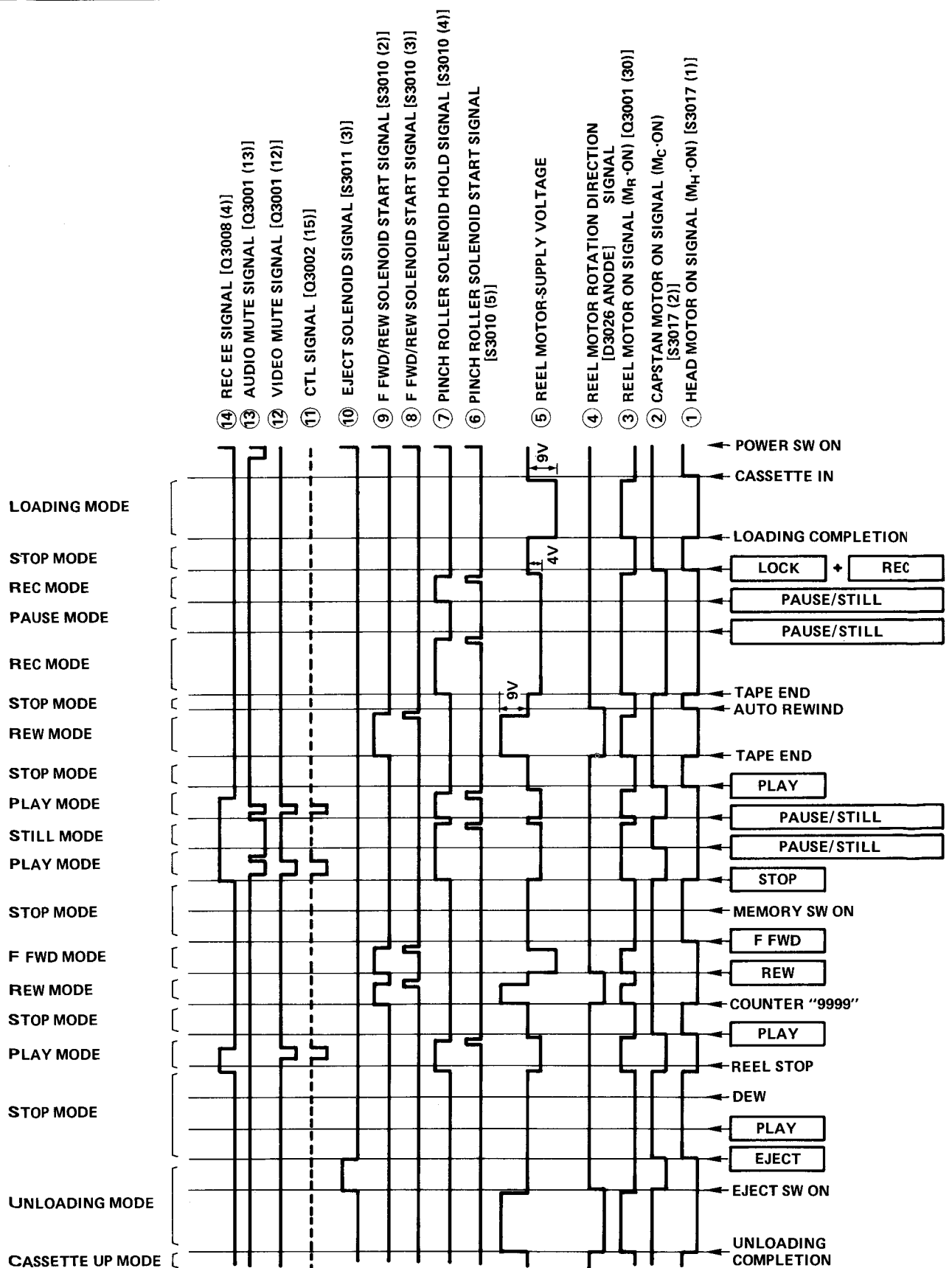


Fig. 2-3-12 Operation timing chart

- (d) When the eject switch becomes ON, the mode changes to UNLOADING.

When the mode changes to UNLOADING:

- (a) Pin (26) of Q3001 becomes LOW, and the MH-ON signal is supplied to pin (1) of S3017.
- (b) Pin (30) of A3001 becomes LOW; this signal passes through pins (2) → (13) → (3) → (12) of Q3009 → Q3017, Q3018 [regarding Q3018, pin (9) of Q3004 becomes HIGH, and Q3018 switches ON], Q3019, Q3021, and approximately 9 V DC is applied to the minus (-) terminal of the reel motor. The plus (+) terminal is earthed through Q3022, the reel motor starts rotating in the reverse direction, and the loading ring rotates.
- (c) Once unloading is completed, the cassette switch becomes OFF, and the cassette holder rises.

Each of the modes and the corresponding signals are shown in Table 2-3-5 and Table 2-3-6.

In addition, the operation timing chart is shown in Fig. 2-3-12.

2. Tape End Sensor Circuit

The tape end sensor circuit is shown in Fig. 2-3-13. The tape end sensor circuit consists of a sensor coil, a capacitor resonance circuit, and an operational amplifier oscillator circuit (during oscillation, the oscillation frequency is 200 kHz and the oscillation voltage is 0.3 V_{p-p}). The end of the tape is detected by using the dip of the Q of the sensor coil caused by the aluminium part of the tape. Pin (14) of Q3005 becomes HIGH during the REW mode at the channel 1 (forward sensor) and channel 2 (rewind sensor) switching input terminal, and the switch is set to the reverse sensor.

When the tape is travelling in the reverse direction during the REW mode and the end of the tape is reached, oscillation will cease, the output [pin (13) of Q3005] will become LOW, pin (11) of the input expander LC7800 (Q3002) will become LOW, and the VCR will automatically stop.

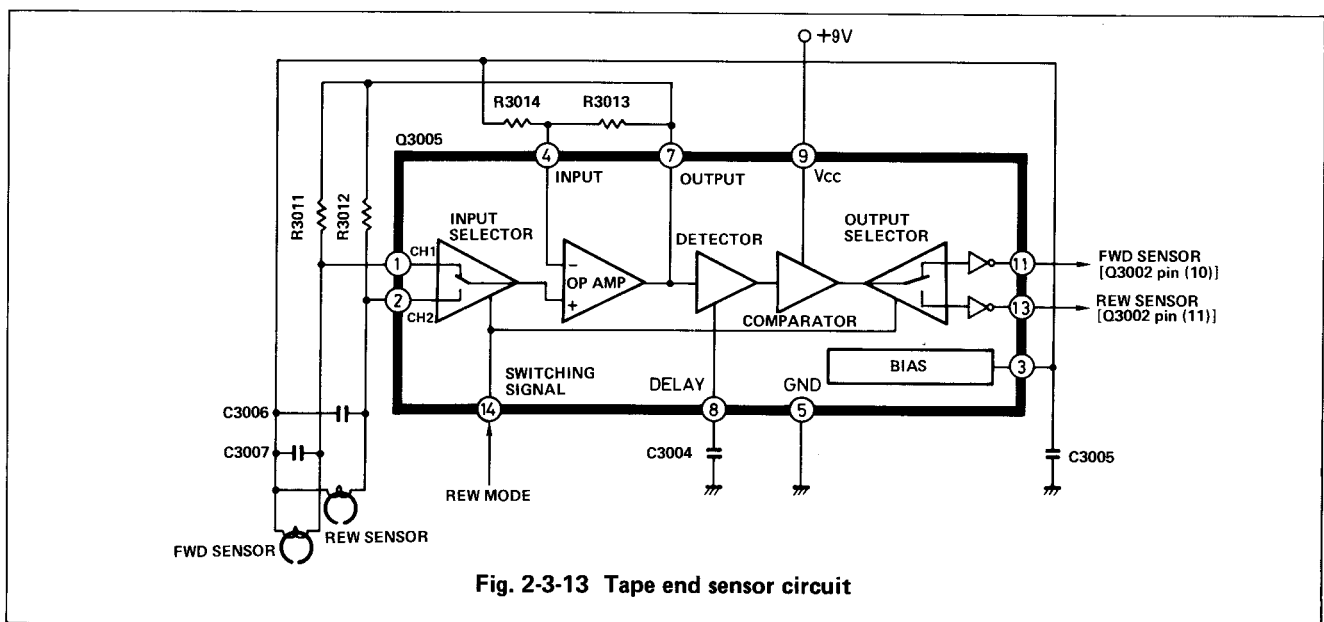


Fig. 2-3-13 Tape end sensor circuit

3. Sensor Circuits

The block diagram of the sensor circuits is shown in Fig. 2-3-14.

a. Dew circuit

The condensation (dew) condition of the VCR is detected by using a sensor whose resistance value varies according to humidity. The resistance value of the dew sensor is 1000 Megohms or more during dry times, and from 20 to 200 kilohms during condensation; therefore, if condensation occurs, the voltage of pin (10) of BA6135 (Q3006) will drop, both pin (9) and pin (9) of Q3003 will become LOW, and the VCR will automatically stop.

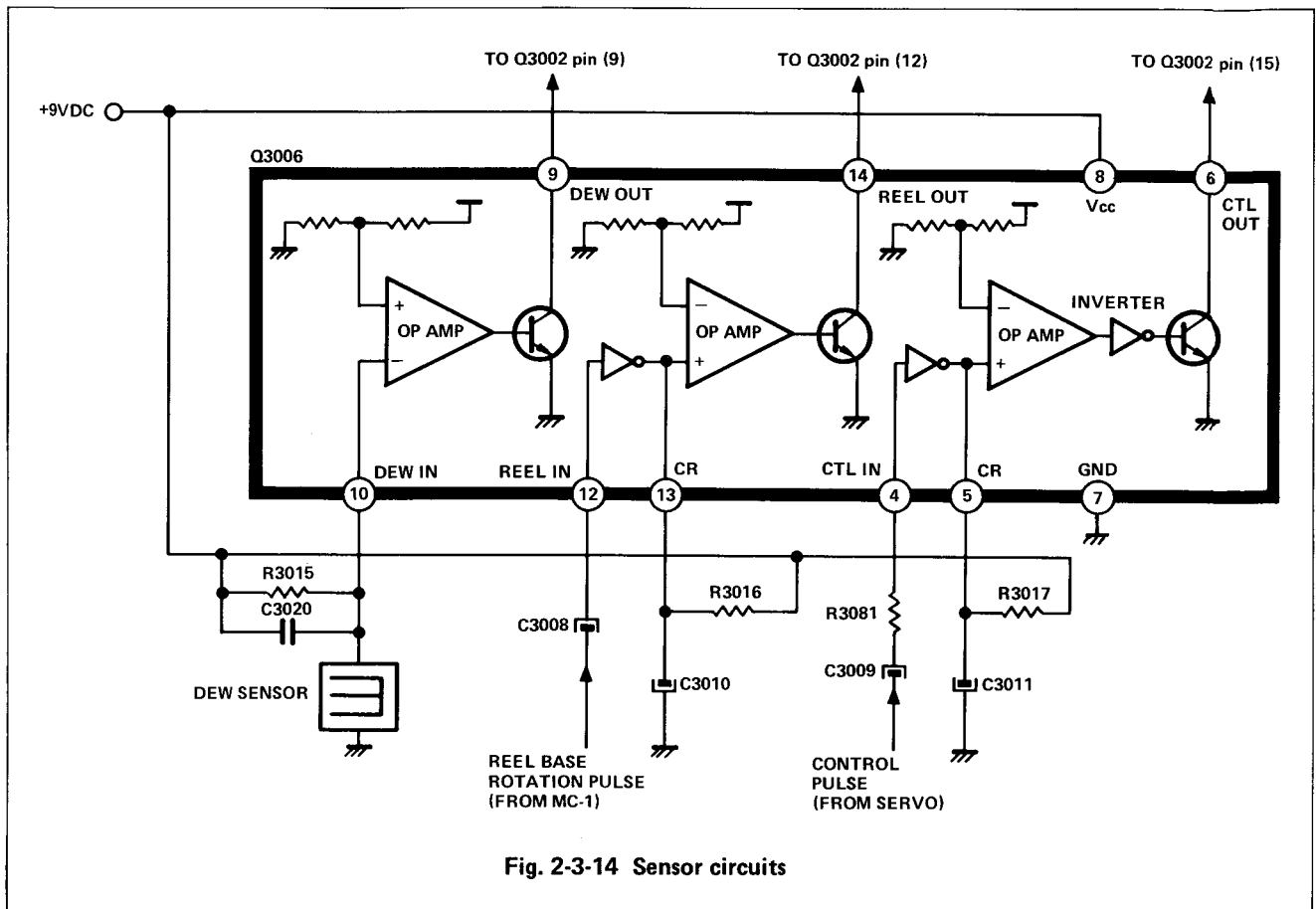
b. Reel base rotation sensor circuit

A signal from the reel base rotation detection mechanism

(a ring-like magnet on the MC-1 circuit board), which consists of a magnet and a magnetic resistance element, is input to pin (12) of Q3006. If the reel base ceases rotation, C3010 will be charged through R3016, pin (14) of Q3006 and pin (12) of Q3002 will both become LOW, and the VCR will automatically stop.

c. Control pulse detection circuit

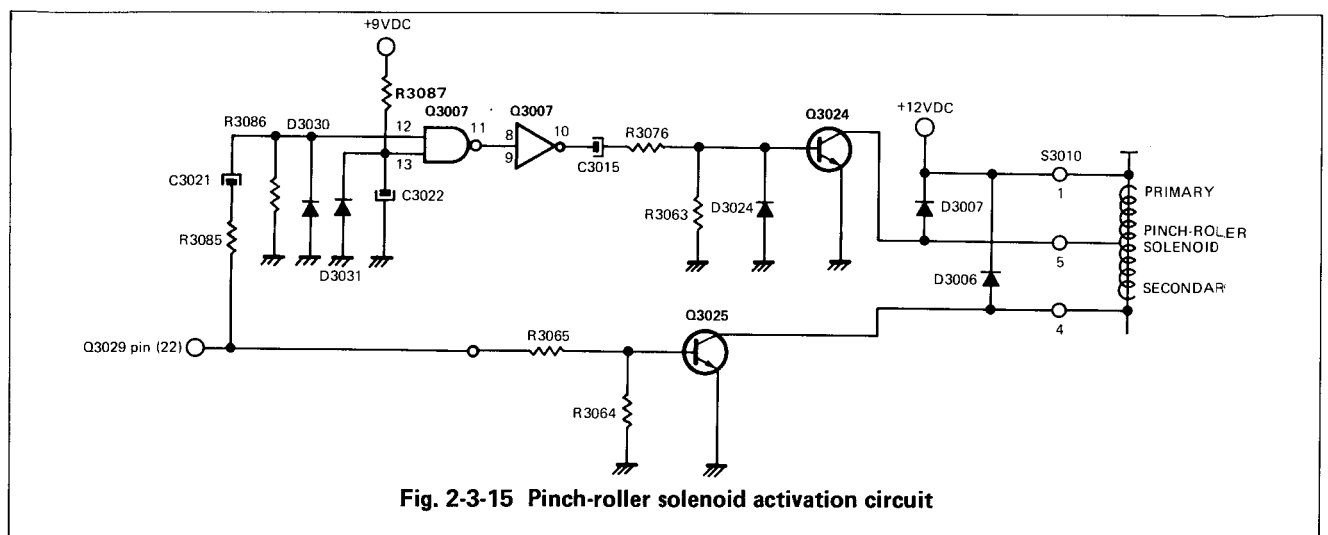
The reproduced control pulse normally is input to pin (4) of Q3006 from the servo circuit when a control pulse is not reproduced on the unrecorded parts of the tape; the signal ceases to be input to pin (4), C3011 is charged through R3017, pin (6) of Q3006 and pin (15) of Q3002 both become HIGH, and audio muting and video muting signals are output.



4. Solenoid Drive Circuitry

The pinch-roller solenoid drive circuit is shown in Fig. 2-3-15. If the PLAY button is pressed and the pinch-roller solenoid is activated, the pinch-roller solenoid activation signal [pin (9) of Q3001] will become HIGH for 150 milliseconds, transistor Q3024 will switch ON for the same period of time, and activation current will flow to the primary side winding of the pinch-roller solenoid. For the duration of pinch-roller solenoid hold, the pinch-

roller solenoid hold signal [pin (22) of Q3029] is HIGH, transistor Q3025 is switched ON, and current will flow to both the primary winding and the secondary winding of the pinch-roller solenoid; thus accomplishing solenoid hold even after activation is finished. Using this type of drive system has made it possible to reduce the amount of electrical power consumed during holding. Diodes D3006 and D3007 are the diodes for surge current absorption.



5. Reel Motor Drive Circuit

The reel motor drive circuit is shown in Fig. 2-3-16.

a. REC, PLAY, and PAUSE modes

The reel motor ON signal becomes LOW, Q3017 switches ON, and the voltage determined by R3051 and R3052 is supplied to the base of Q3019 through D3023. In addition, the current will flow in the following order: emitter of Q3019 → emitter of Q3020 → collector → reel motor → collector of Q3023 → emitter; and the reel motor will rotate in the forward direction at a speed of approximately 1,000 rpm.

b. FWD and LOADING modes

Q3017 and Q3018 will both switch ON, and the collector

voltage of Q3018 will be supplied to the base of Q3019. In addition, the current will flow in the following order: emitter of Q3019 → emitter of Q3020 → collector → reel motor → collector of Q3023 → emitter; and the reel motor will rotate in the forward direction at a speed of 4,000 rpm.

c. REW and UNLOADING modes

Q3017 and Q3018 will both switch ON, and the collector voltage of Q3018 will be supplied to the base of Q3019. In addition, the current will flow in the following order: emitter of Q3019 → emitter of Q3021 → collector → reel motor → collector of Q3022 → emitter; and the reel motor will rotate in the reverse direction at a speed of 4,000 rpm.

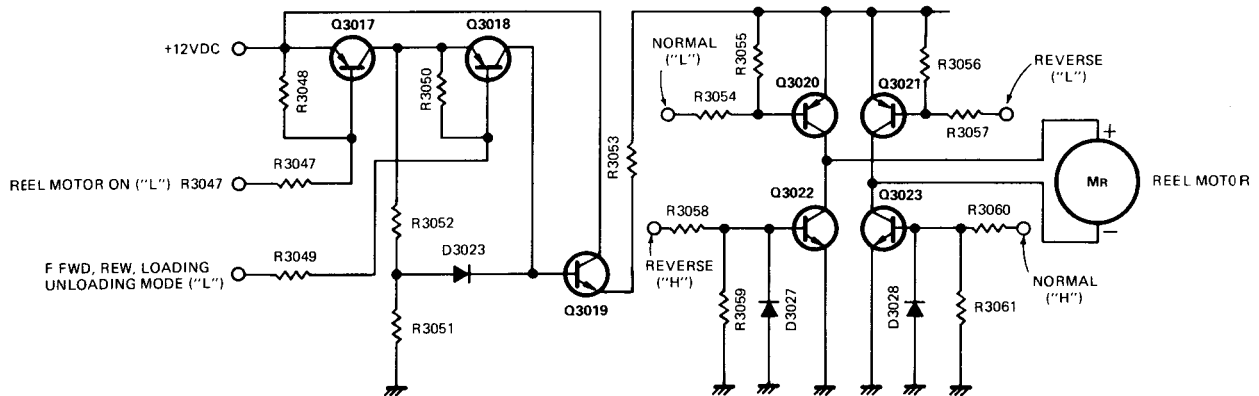


Fig. 2-3-16 Reel motor drive circuit

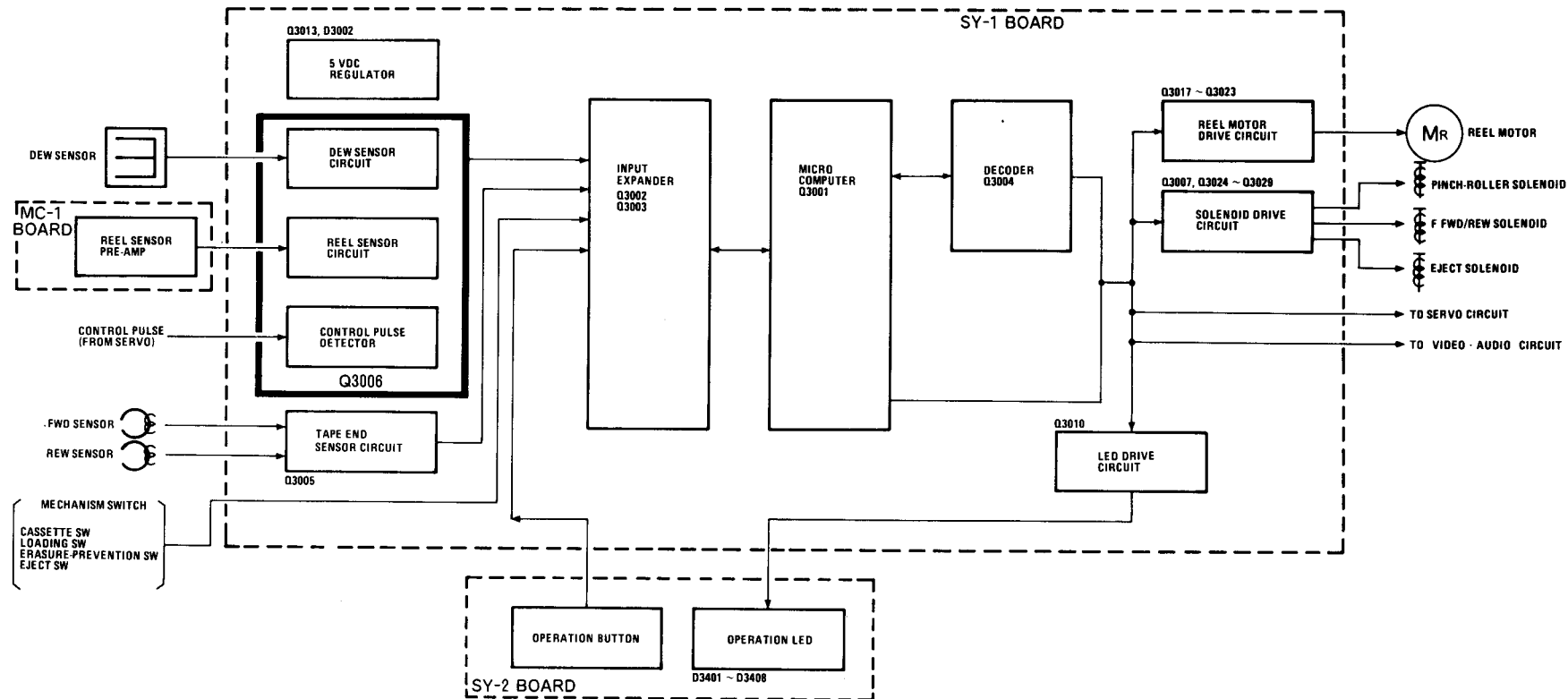


Fig. 2-3-17 System control circuit block diagram

Button Previous mode	STOP	REC + LOCK	PLAY	PAUSE	F FWD	REW	EJECT
STOP	—	↓ REC	↓ PLAY	—	↓ F FWD	↓ REW	UNLOADING ↓ CASSETTE UP
REC	↓ STOP	—	↓ PLAY	↓ PAUSE	↓ F FWD	↓ REW	STOP ↓ UNLOADING ↓ CASSETTE UP
PLAY	↓ STOP	↓ REC	—	↓ STILL	↓ F SEARCH	STOP ↓ R SEARCH	STOP ↓ UNLOADING ↓ CASSETTE UP
PAUSE	↓ STOP	—	↓ STILL	↓ REC	↓ F FWD	↓ REW	STOP ↓ UNLOADING ↓ CASSETTE UP
F FWD	↓ STOP	STOP ↓ REC	STOP ↓ PLAY	—	—	STOP ↓ REW	STOP ↓ UNLOADING ↓ CASSETTE UP
REW	↓ STOP	STOP ↓ REC	STOP ↓ PLAY	—	STOP ↓ REW	—	STOP ↓ UNLOADING ↓ CASSETTE UP
CASSETTE UP	—	—	—	—	—	—	STOP ↓ UNLOADING ↓ CASSETTE UP
LOADING	LOADING ↓ STOP	LOADING ↓ STOP ↓ REC	LOADING ↓ STOP ↓ PLAY	—	LOADING ↓ F FWD	LOADING ↓ REW	STOP ↓ UNLOADING ↓ CASSETTE UP
UNLOADING	—	—	—	—	—	—	—

Table 2-3-8 Push button logic

V. AUDIO CIRCUIT

1. Outline

The audio circuit (AD-1 circuit board) combines the EQ-amplifier, microphone amplifier, recording amplifier, and the record/playback selection switch into a one-chip IC (Q2001) construction. A block diagram of the audio circuit is shown in Fig. 2-4-1.

2. EE Mode (Refer to Fig. 2-4-1.)

The audio signal input to terminal (1) of S2001 is input to pin (18) of Q2001 and, after being amplified by the microphone amplifier, is output from pin (4).

The signal output from pin (4) of Q2001 passes through the low pass filter, which is composed of L2003 and C2024, and is input to pin (9). After being amplified by the line amplifier, it is output from pin (10) of Q2001. This part is changed to direct current by the rectifier circuit and is input to pin (16) of Q2001. Pin (16) and pin (17) input a direct current to the base of the IC internal circuit which is connected to pin (16) of Q2001. The input of pin (18) is controlled in accordance with the control of the resistance variation between the collector of the IC internal circuit connected to pin (17) and earth.

The signal output to pin (10) of Q2001, after being adjusted by VR2002, is input to pin (12), passes through the recording amplifier, and is output from pin (13) of Q2001. In addition, the signal output from pin (13) of Q2001 acts as feedback according to the internal resistance of the IC, and also emphasizes the high frequencies according to the peaking circuit composed of L2002, R2012, and C2009. The signal output from pin (13) of Q2001 also passes through the bias trap composed of L2001 and C2015 and, when Q2002 and Q2003 are released (during recording), is supplied to the audio/control head as recording current.

3. REC Mode (Refer to Fig. 2-4-2.)

Other than in the EE mode, the oscillator circuit (which supplies the audio/control head with a bias current and supplies the audio erase head and the full erase head with an erasing current) operates, and, in conjunction with this, a recording current is supplied to the audio/control head.

This is called the REC mode. REC + B is supplied from the video section, passes through R2038 and L2004, and causes oscillation. Simultaneously, Q2002, Q2003, and Q2005 are released by D2024.

4. PLAY Mode (Refer to Fig. 2-4-3.)

Play + B is supplied from the video section, and Q2008 operates. This releases Q2004, and also supplies high level voltage to pin (14) of Q2001. Fig. 2-4-4 shows the relationship between the voltage of pin (14) of Q2001 and each mode.

As shown in Fig. 2-4-4, muting is applied when the voltage of the EE mode, the REC mode, and the PLAY mode reaches approximately its halfway level. When the mute signal (approximately 9 V) from the system control circuit is input to terminal (5) of S2005, Q2010 is switched ON and muting is applied.

As mentioned previously, Q2004 is in a released condition. Therefore, when the signal from the audio/control head is input to pin (2) of Q2001, it is output to pin (4) of Q2001. This signal passes through R2021, C2021, VR2001, R2018, and C2018, applies negative feedback to pin (3) of Q2001, and composes the equalizer.

The signal output to pin (4) of Q2001 passes through the low pass filter just as during recording, and is input from VR2004 to pin (8); it then passes through the line amplifier, and is output to pin (10) of Q2001.

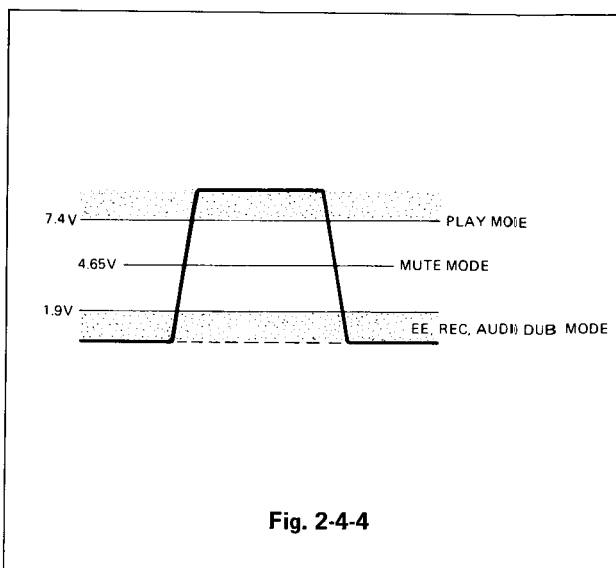


Fig. 2-4-4

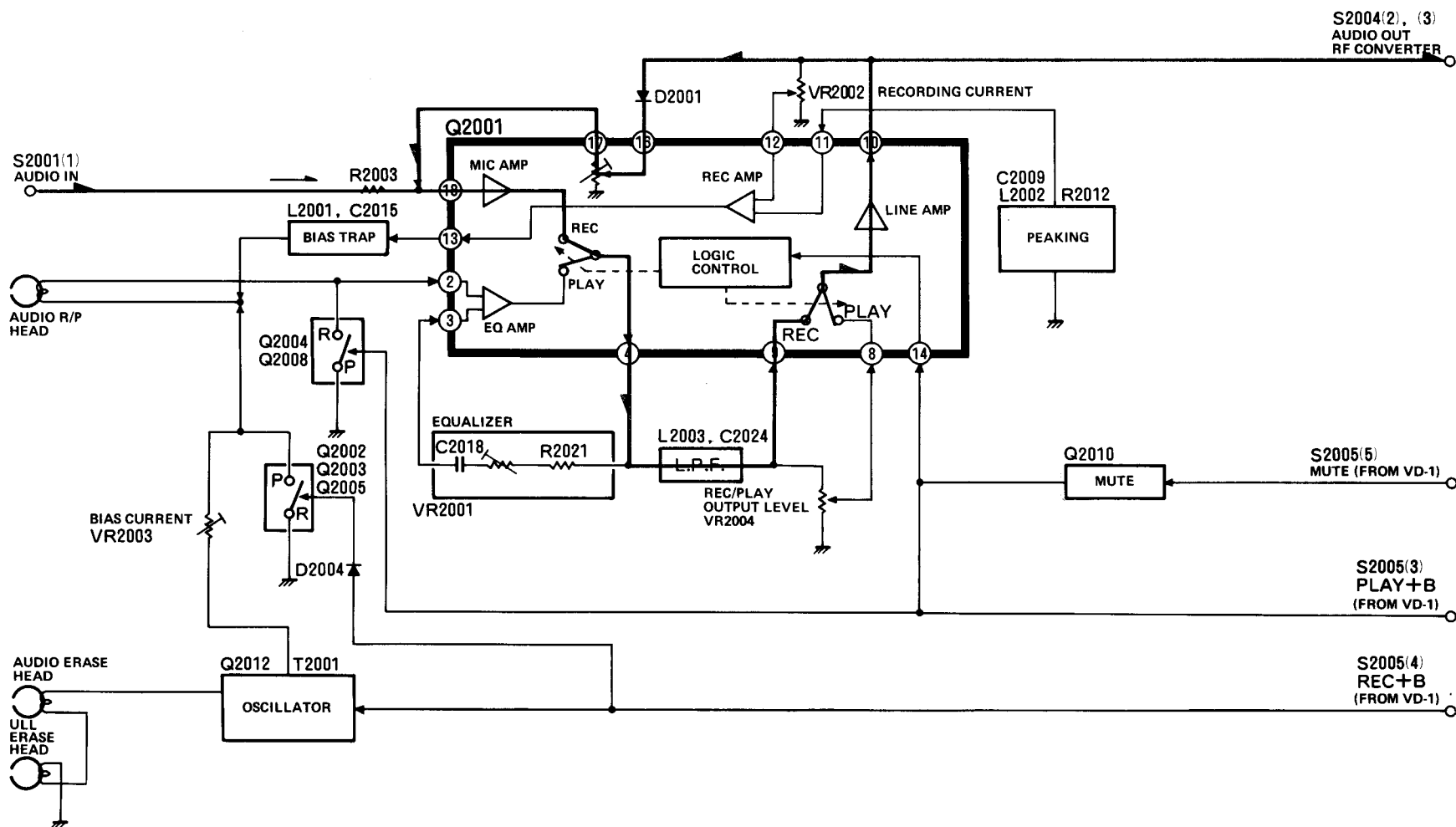


Fig. 2-4-1 Audio Circuit Block Diagram (FF mode)

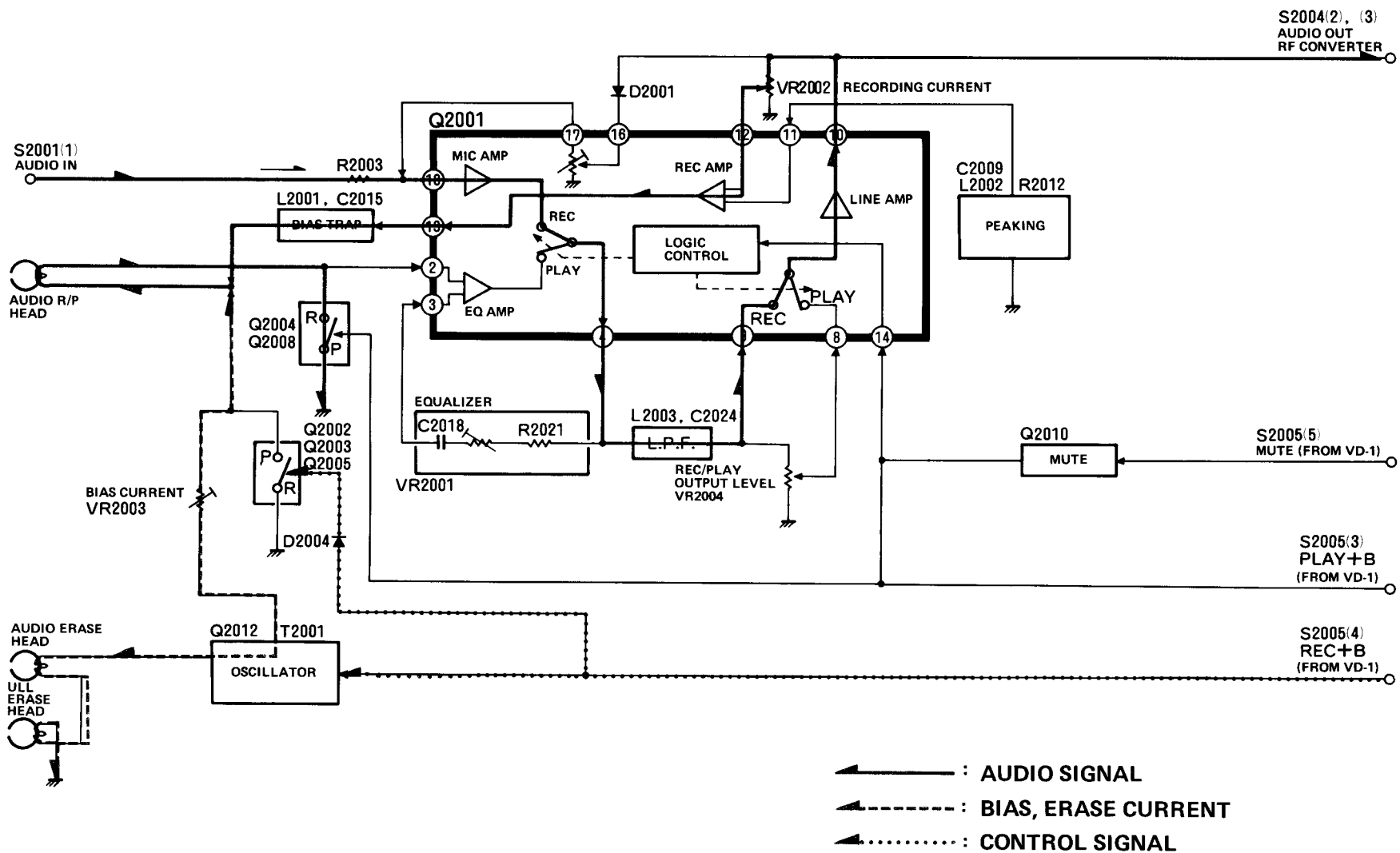


Fig. 2-4-2 Audio Circuit Block Diagram (REC mode)

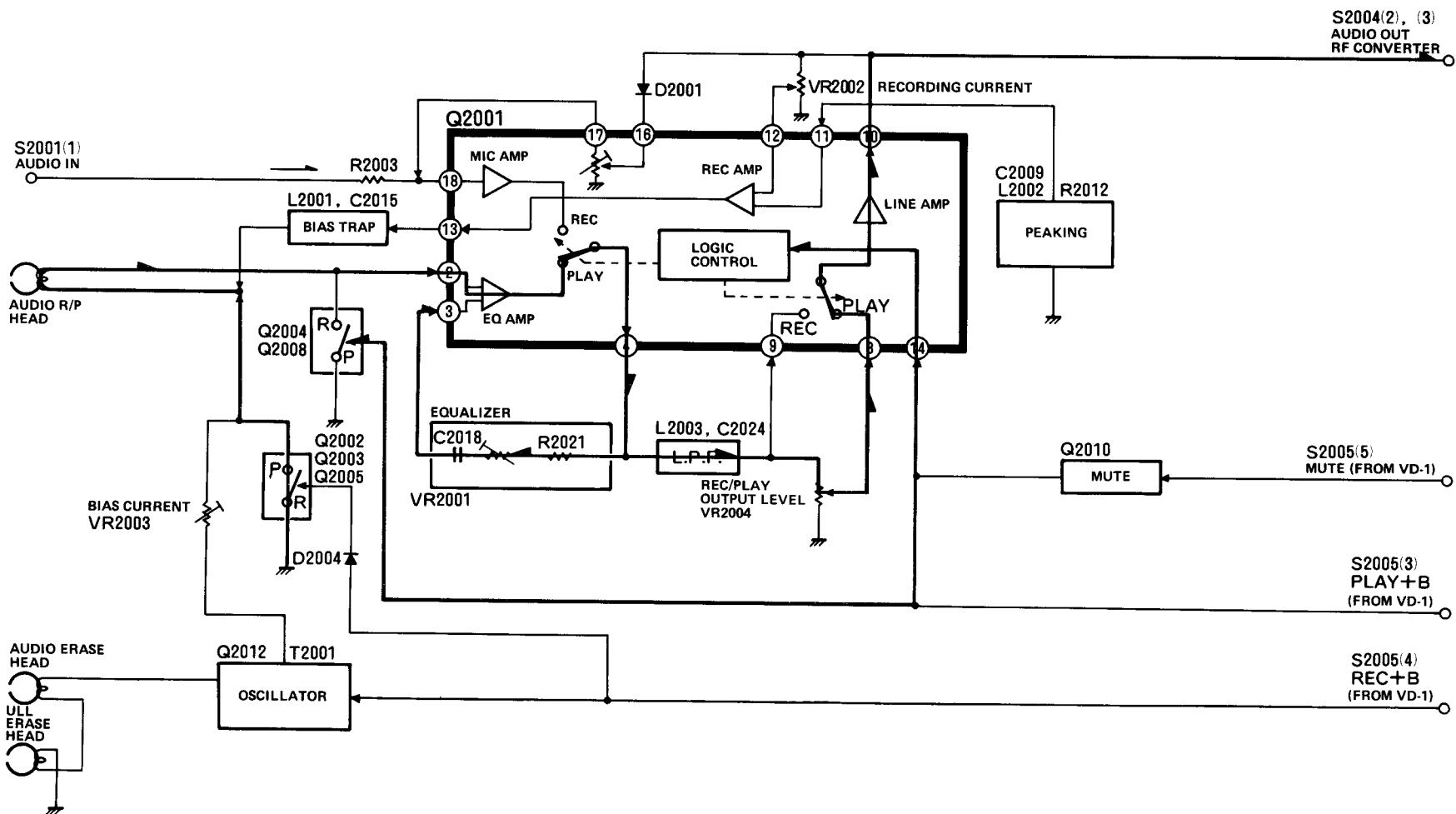


Fig. 2-4-3 Audio Circuit Block Diagram (PLAY mode)

VI. TIMER CIRCUIT

1. Outline

The timer circuit is mainly composed of a microcomputer. It contains, together with the timer function, a built-in one-programme per week recording function.

a. Timer function

The timer function is controlled by a power supply synchronous timer which utilizes a 50-Hz input as its clock frequency. The digital display flashes when power is first supplied to the VCR.

b. One programme per week function

It is possible to preset the starting time and the ending time for recording one programme up to one week in advance. It is also possible to record one programme automatically at the same time each day.

This timer circuit switches off the power to the VCR when the tape reaches its end regardless of the previously set ending time.

c. Digital display

The timer readout is indicated on an easy-to-read digital

display. The digital display operates by a static type lighting system.

d. Setting the timer

The time can be adjusted and the timer can be set only while the POWER ON button is in the pressed position.

2. Circuit Structure

As is shown in Fig. 2-5-1, the timer circuit is mainly composed of a microcomputer, a fluorescent display, a key matrix circuit, an oscillation circuit, etc.

3. Timer Circuit Input/Output Signals

The signal from the system control circuit is input to the timer circuit along with the signals [the AC 2.4 V signal, the ALLWAY + 15 V signal, the TIMER (T/S) + 15 V signal (only when the timer button is pressed), and the REC PAUSE signal (only during recording)] which are input from the power supply circuit. Also, a TIMER OUT signal and a REW STOP signal are output from the timer circuit to the system control circuit (SY-1 circuit board), and a TIMER OUT signal is output from the timer circuit to the power supply circuit.

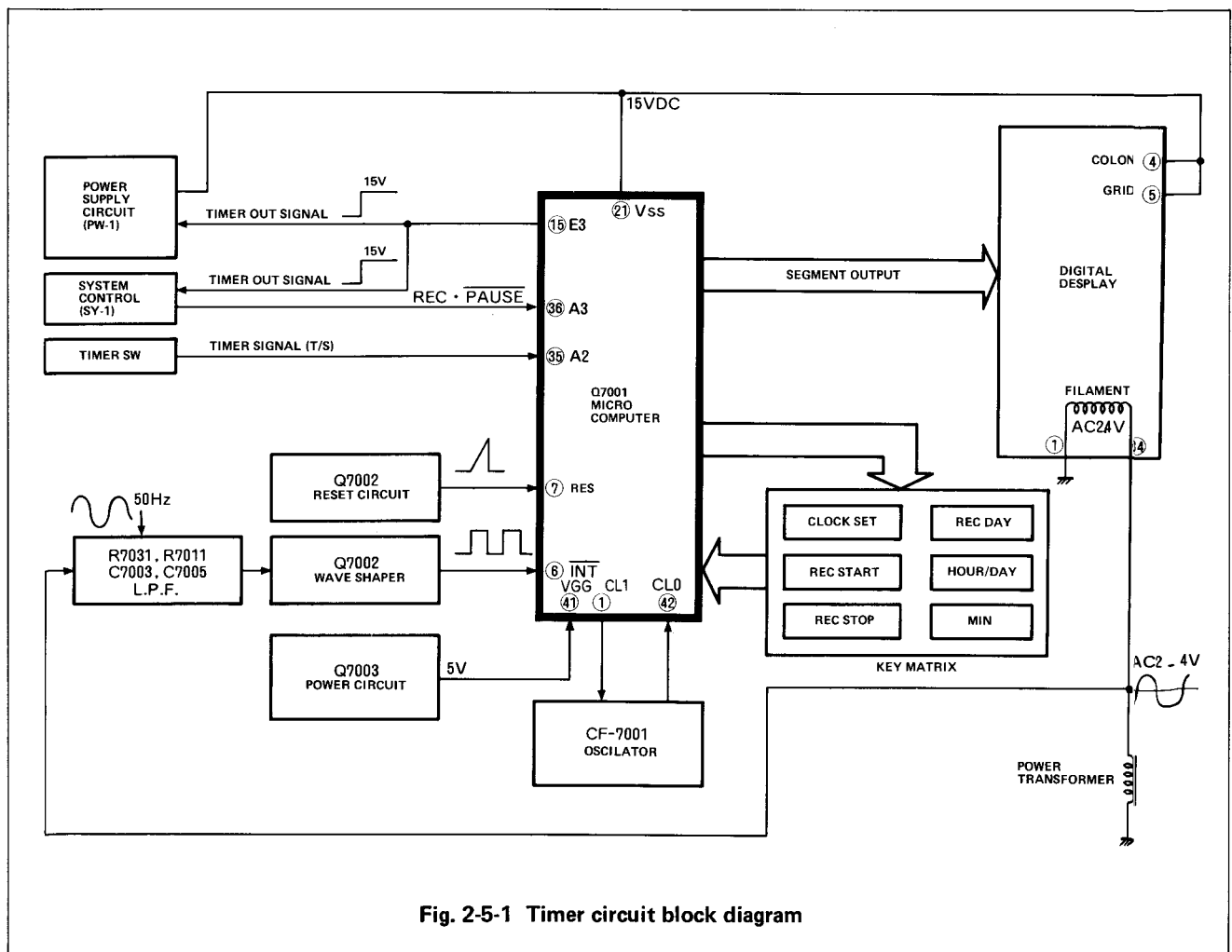


Fig. 2-5-1 Timer circuit block diagram

4. Current Time Display

The current time is indicated on the fluorescent display. This indication occurs when the clock pulse (50 Hz) which is applied to pin (6) of Q7001 is converted into segment output by Q7001, and then output from pin (2) ~ pin (11), pin (16) ~ pin (19), and pin (22) ~ pin (32) of Q7001 to pin (6) ~ pin (33) of the fluorescent display.

- AC 2.4 V is applied to terminal (2) of timer circuit S7001 from terminal (2) of power supply circuit S7003.
- The noise component in the AC power line is eliminated at the clock input circuit by the low-pass filter, which is composed of R7013, C7003, R7011, and C7005. The AC 2.4 V is then input to pin (6) of Q7002.
- After the sine wave from which the noise component has been eliminated is shaped into a short waveform

by the waveform shaping circuit (Q7002), it is input as the clock pulse to pin (6) of Q7001.

- The clock pulse input as a short waveform is counted by the microcomputer (Q7001). Each time this count reaches 50, the time is memorized inside the microcomputer as constituting one second.
- When the seconds memory of the microcomputer reaches 60, +1 is recorded in the minutes memory. In the same way, when the minutes memory reaches 60, +1 is recorded in the hours memory.
- At the rate of once every 3 milliseconds, the microcomputer converts the data in the minutes memory and the hours memory into a segment signal for the fluorescent display, and outputs this to pin (2) ~ pin (11), pin (16) ~ pin (19), and pin (22) ~ pin (32) of Q7001. This output results in the current time indication on the fluorescent display.

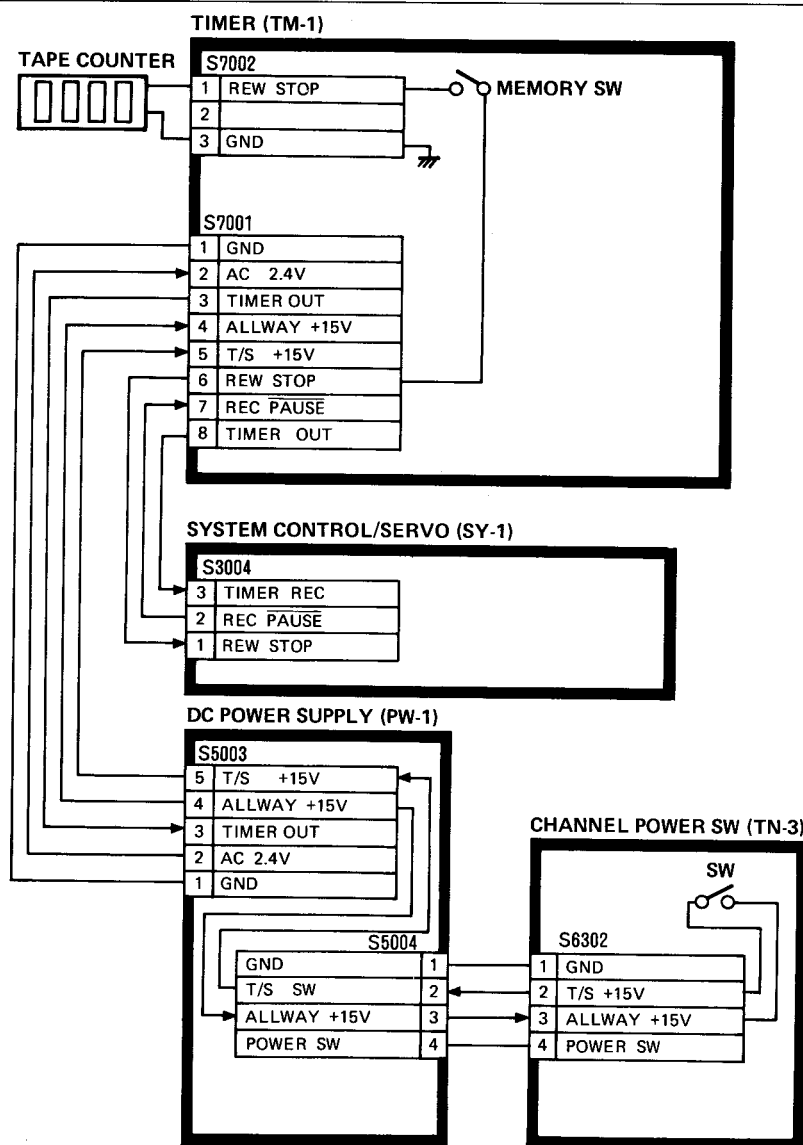


Fig. 2-5-2 Block diagram of timer unit signals

5. Time Display

When the respective button is pressed, the time indication (starting time for recording, ending time for recording, and the day of the week) of the timer is indicated on the fluorescent display. In order to produce this indication, the times (e.g., the starting time for recording) in the memory of the microcomputer are converted to a segment output by the microcomputer, and output from pin (2) ~ pin (11), pin (16) ~ pin (19), pin (22), and pin (23) of Q7001 to pin (6) ~ pin (33) of the fluorescent display.

- As shown in Fig. 2-5-3, when the REC START button (SW7003) is pressed, the key scan signal from the key matrix circuit is input to the microcomputer (Q7001).
- When the microcomputer determines that the REC START button (SW7003) has been pressed, it retrieves the starting time for recording from its internal memory, and outputs it to the fluorescent display.
- If the MIN button (SW7007) is pressed while the REC START button is being pressed, a signal is input to the microcomputer in the same manner described previously, and the output from pin (2) ~ pin (11), pin (16) ~ pin (19), and pin (22) ~ pin (32), of Q7001 is changed, advancing the minute indication one minute. The minute indication advances in this manner each time the minute button is pressed.
- After the minutes have been changed as described in item c above, releasing the MIN button and then releasing the REC START button will cause the microcomputer to memorize the time output from pin (2) ~ pin (11), pin (16) ~ pin (19), and pin (22) ~ pin (32) of Q7001 as the starting time for recording. The ending time for recording and the day of the week are also memorized in the same way.

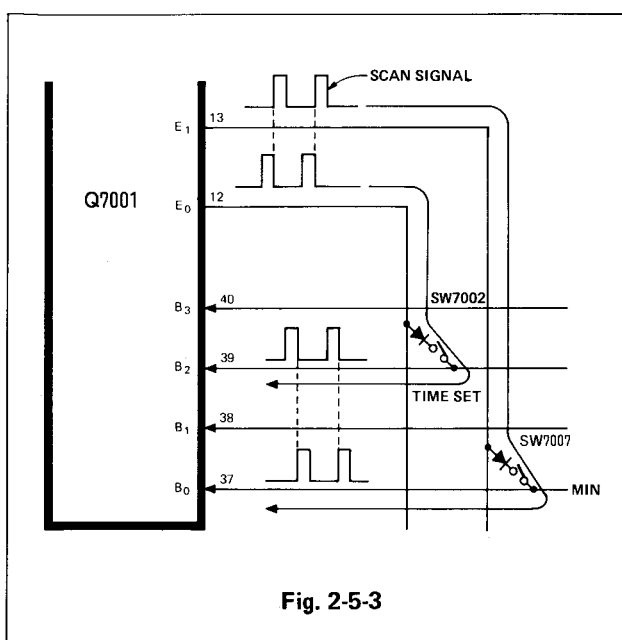


Fig. 2-5-3

6. Timer-Controlled Recording

When the starting time for recording is reached, timer-controlled recording begins. Then, when either the ending time for recording or the end of the tape is reached, timer-controlled recording is canceled, and the power supply is switched to a standby condition.

- Timer-controlled recording can be done only when the TIMER button is in the pressed position. Also, when the TIMER button is in the pressed position, terminal (5) of S7001 becomes +15 V, which switches Q7005 ON, and causes pin (35) of Q7001 to become V_{GG} (+5 V) level.
- If the conditions described in item 1 above have been satisfied, the timer out signal will be output from pin (15) of Q7001 when the starting time for recording is reached (when the day of the week is either d:L or d:E).
- The timer out signal which is output from terminal (15) of Q7001 is output to the system control circuit (SY-1 circuit board) from terminal (8) of S7001 and to the power supply circuit from terminal (3) of S7001.
- When the VCR enters the REC mode, a REC PAUSE signal (+9 V) is input from terminal (2) of S7004 in the system control circuit (SY-1 circuit board) to terminal (7) of S7001 in the timer circuit.
- The REC PAUSE signal which is input to terminal (7) of S7001 passes through R7024 and is input to the base of Q7006. Q7006 then switches ON, and the collector of Q7006 becomes earth potential. Also, because R7031 is connected to earth and to the base of Q7007, Q7007 also switches ON, and pin (36) of Q7001 becomes V_{GG} (+5 V) level.
- When the REC PAUSE signal is input, the microcomputer (Q7001) determines that the VCR is performing timer-controlled recording normally, and it continues to output a timer out signal until the ending time for recording is reached.
- When the ending time for recording is reached, the timer out signal from pin (15) of Q7001 is switched OFF. The timer out signal from terminal (3) and from terminal (8) of S7001 ceases to be output, and the VCR is switched to a standby condition.
- When the tape comes to its end, the system control circuit (SY-1 circuit board) stops inputting the REC PAUSE signal to terminal (7) of S7001, and, as a result, Q7006 and Q7007 are switched OFF, and pin (36) of Q7001 becomes V_{ss} (+15 V) level.
- When pin (35) of Q7001 becomes V_{ss} (+15 V) level, the microcomputer determines that the tape has reached its end, and it switches off the timer out signal which is output from pin (15) of Q7001. The timer out signal from terminal (3) and terminal (8) of S7001 then ceases to be output, and the VCR is switched to a standby condition.

7. When Timer-Controlled Recording is Completed

When timer-controlled recording is completed, the starting time for recording and the ending time for recording in the memory of the microcomputer are cleared. As a result, when the REC START button is pressed, the cleared starting time for recording is output from pin (2) ~ pin (11), pin (16) ~ pin (19), and pin (22) ~ pin (32) of Q7001 and the indication [—:—] is indicated on the fluorescent display.

However, in the everyday recording mode [d:E], even at the end of timer-controlled recording, the starting time for recording and the ending time for recording are not cleared.

8. Sleep Recording

If the TIMER button is pressed while the POWER ON button is in the pressed position, and the VCR is recording, recording will continue. This is called sleep recording. In the sleep recording function, when the end of the tape is reached, the power supply will automatically switch to the standby condition

- While the POWER ON button is in the pressed position, if the VCR is recording, a REC PAUSE signal is output from terminal (2) of S7004 and input to the timer circuit.
- Pin (36) of Q7001 becomes V_{GG} (+5 V) in the same sequence as for timer-controlled recording.
- If the TIMER button is pressed at this time, +15 V is supplied to terminal (5) of S7001.
- The +15 V input to terminal (5) of S7001 passes through R7023, enters the base of Q7005, Q7005 switches ON, and pin (35) of Q7001 becomes V_{GG} (+5 V). At this time, both pin (35) and pin (36) of Q7001 are at V_{GG} level, a timer out signal is output

from pin (15) of Q7001, and the condition of the VCR is the same condition as that for timer-controlled recording.

- Sleep recording ends at the end of the tape. It is exactly the same operation as when timer-controlled recording ends at the end of the tape.

9. Oscillation Circuit

The oscillation circuit is composed of pin (1) and (42) of Q7001, and the ceramic oscillators (F7001, R7015, C7008, and C7009). The oscillation frequency is 400 kHz $\pm$ 5 kHz.

10. Reset Circuit

The microcomputer (Q7001) must be reset when power is supplied. The reset circuit is shown in Fig. 2-5-4.

The changing of input terminals (a) and (b) of Q7002 as shown in Fig. 2-5-5, generates a triangular wave, and inputs to pin (7) of Q7001. As a result, the microcomputer is reset, and executes the program from the beginning.

At the beginning of the program, there is an order to cause the current time readout to flash on and off. The "0:00" readout output from pin (2) ~ pin (11), pin (16) ~ pin (19), and pin (22) ~ pin (32) flashes on and off, and is output to pin (6) ~ pin (33) of the fluorescent display.

11. REW STOP signal

Because the MEMORY switch of the tape counter is connected to the timer circuit board, that signal is output to system control circuit (SY-1 circuit board).

The REW STOP signal has no relation to the operation of the timer circuit.

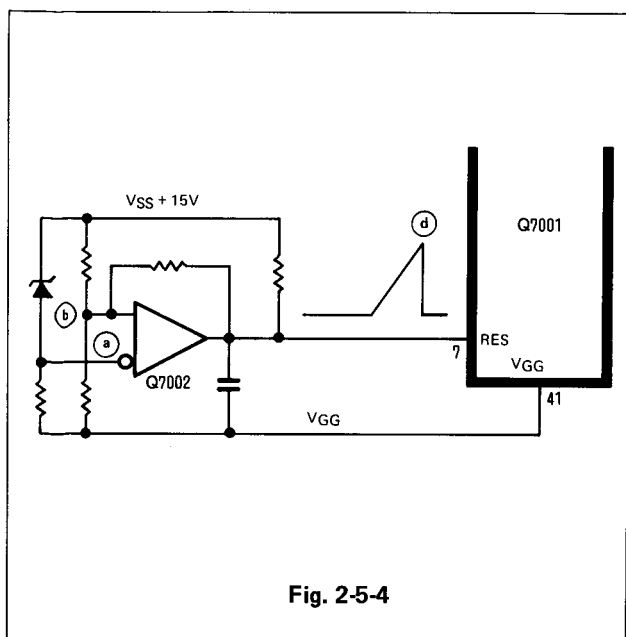


Fig. 2-5-4

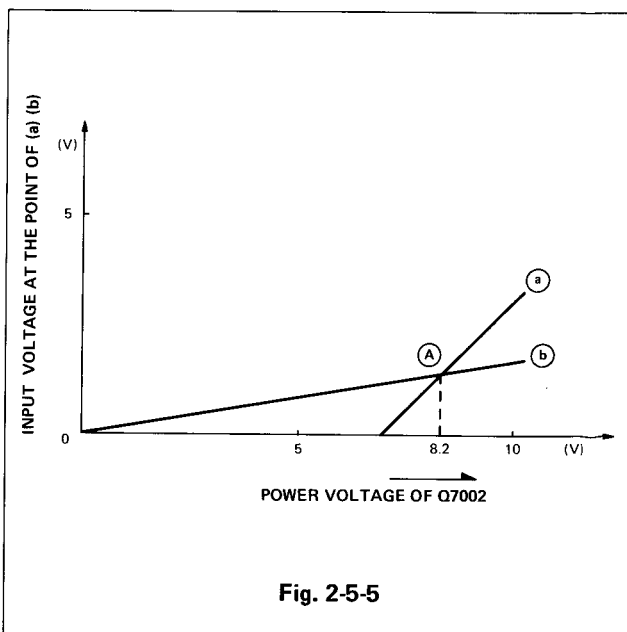


Fig. 2-5-5

VII. TUNER CIRCUIT

A. TUNER CIRCUIT

This is a UHF/VHF combination tuner which receives TV

signals in the European 2 through 12 and 21 through 69 channel bands. (Refer to the block diagram in Fig. 2-6-1.)

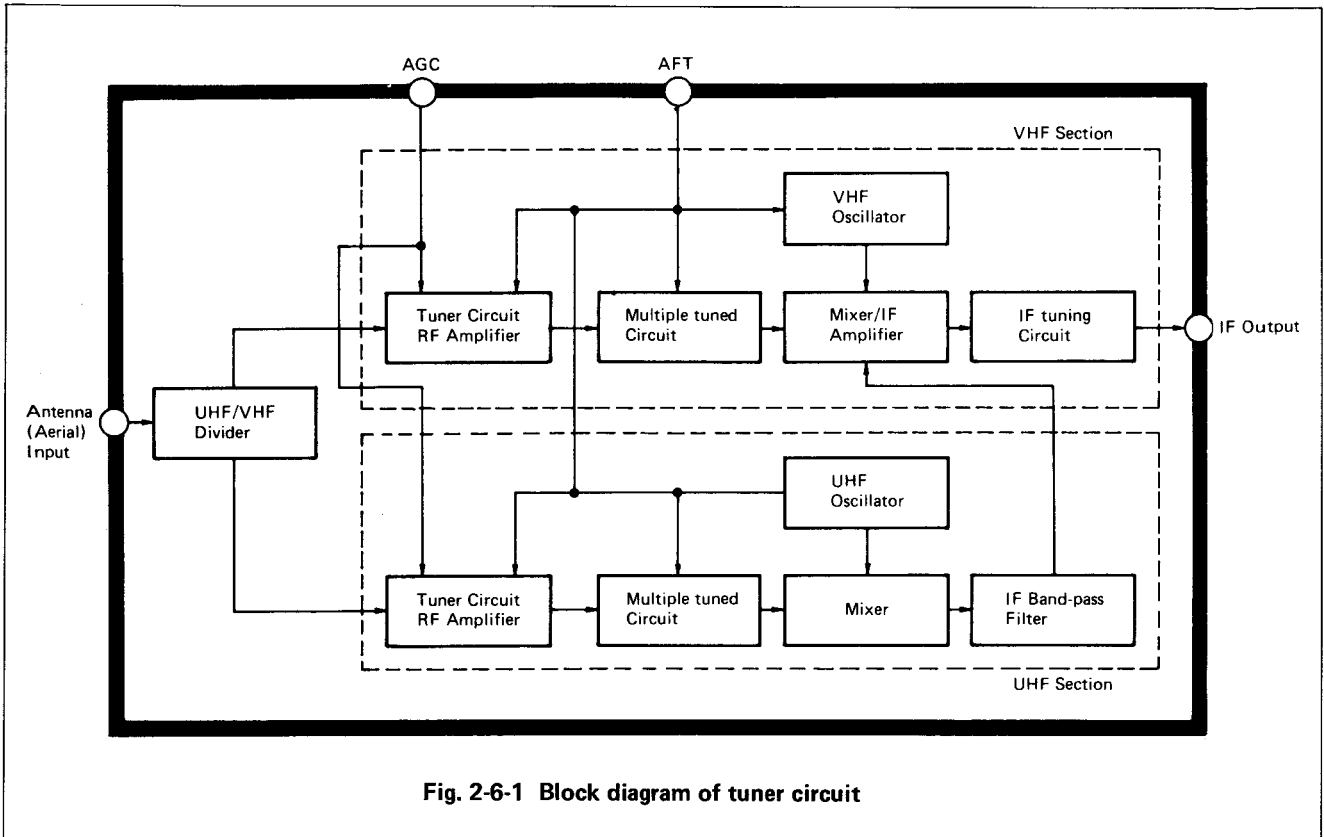


Fig. 2-6-1 Block diagram of tuner circuit

a. Antenna

The antenna employs a phono jack

b. UHF/VHF divider

The UHF/VHF divider employs a low-pass filter and a high-pass filter to divide the UHF and VHF signals.

c. VHF tuner circuit and RF amplifier

The VHF tuner circuit and the RF amplifier suppress all signals other than the desired channel signal and amplifies the desired channel signal. The AGC circuit is engaged by the signal strength and the output voltage is made uniform.

d. Multiple tuned circuit

The multiple tuned circuit has high selectivity characteristics and suppresses all signals other than the desired signal.

e. Oscillator circuit

The oscillator circuit generates the signal required for converting the desired signal into the IF signal.

f. Mixer/IF amplifier

This circuit functions as the VHF mixer and UHF IF

amplifier. When VHF signals are received, the output signal of the VHF oscillator and the channel signal being received are mixed and converted into the IF signal. When UHF signals are received, the circuit functions to amplify the signals which are converted into the IF signal.

g. IF tuning circuit

This is the single tuned circuit for the IF signal.

h. UHF section

The UHF section contains the following circuit: just like the VHF section:

- (1) Tuned circuit/RF amplifier
- (2) Multiple tuned circuit
- (3) Oscillator
- (4) UHF mixer

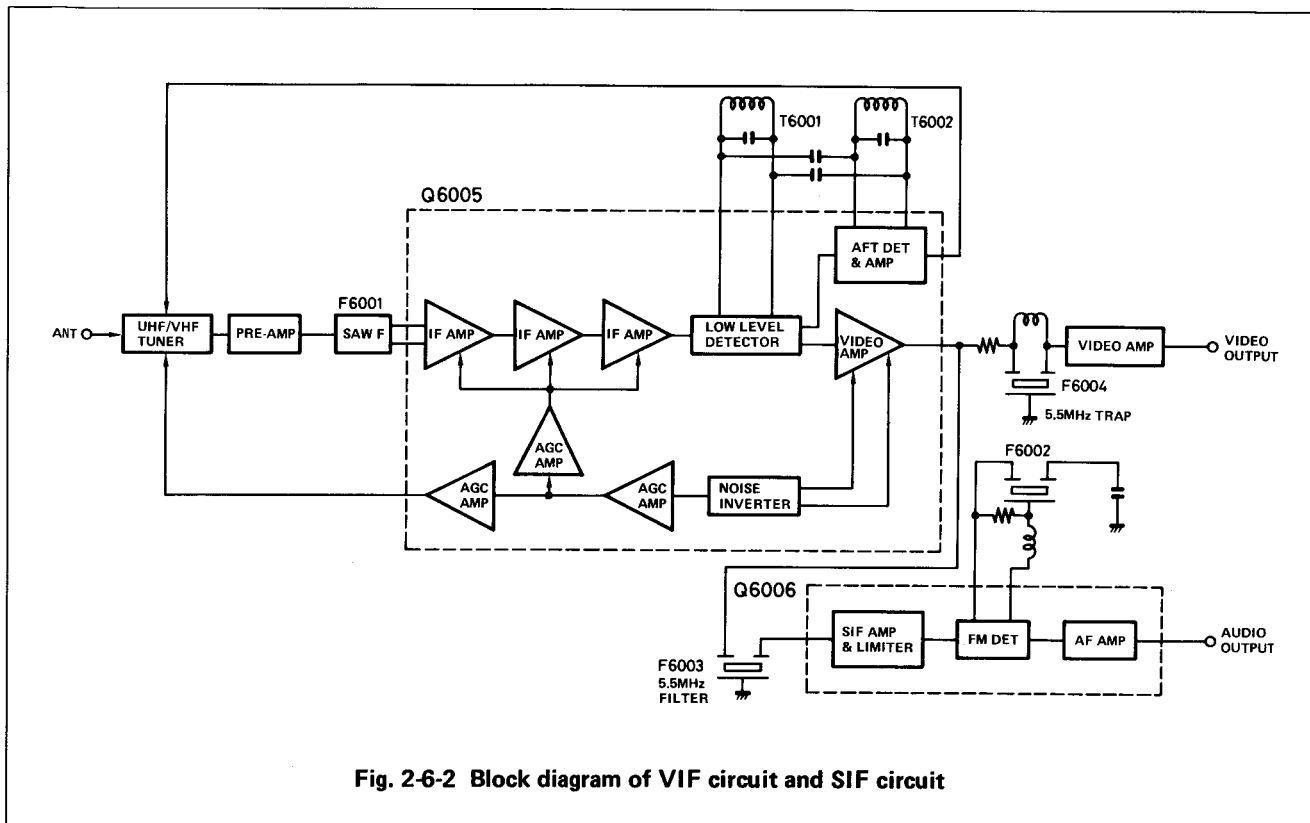
An IF bandpass filter with high selectivity characteristics is employed.

i. AFT

The AFT circuit maintains the IF output signal frequency at a constant level.

B. VIF CIRCUIT

The VIF circuit serves to obtain the required selectivity response and to amplify and video detect the VIF signal. (Refer to the block diagram in Fig. 2-6-2.)



a. Pre-amplifier

The required selectivity characteristics are produced by the surface acoustic wave filter (SAW F). The SAW filter also experiences a loss effect and, therefore, an amplifier is required to compensate for this loss. In order to improve the signal to noise ratio, an emitter-earthed single-stage amplifier (Q6001) is employed before the SAW filter.

b. VIF amplifier, video detector, AFT, and AGC

The VIF signal enters Q6005 from the SAW filter. This IC is composed of the VIF amplifier, the video detector,

the AFT circuit, and the AGC circuit. (Refer to Fig. 2-6-4.)

(1) VIF amplifier

The signal is amplified by this 3-stage variable gain IF amplifier.

(2) Video detector

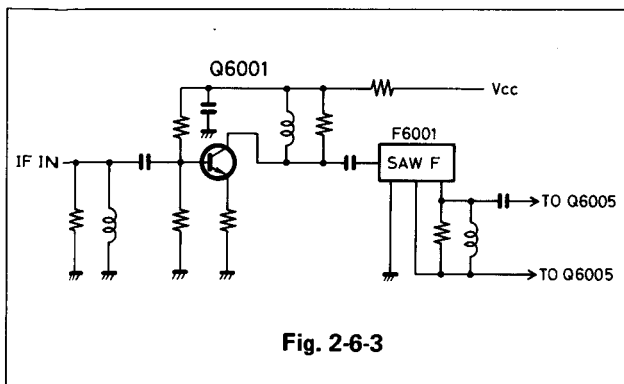
The amplified VIF signal is supplied to the tuning circuit composed of T6001 and C6011, and sync detection is performed. The detected video signal is video amplified while its signal-to-noise ratio is simultaneously improved by the noise inverter circuit.

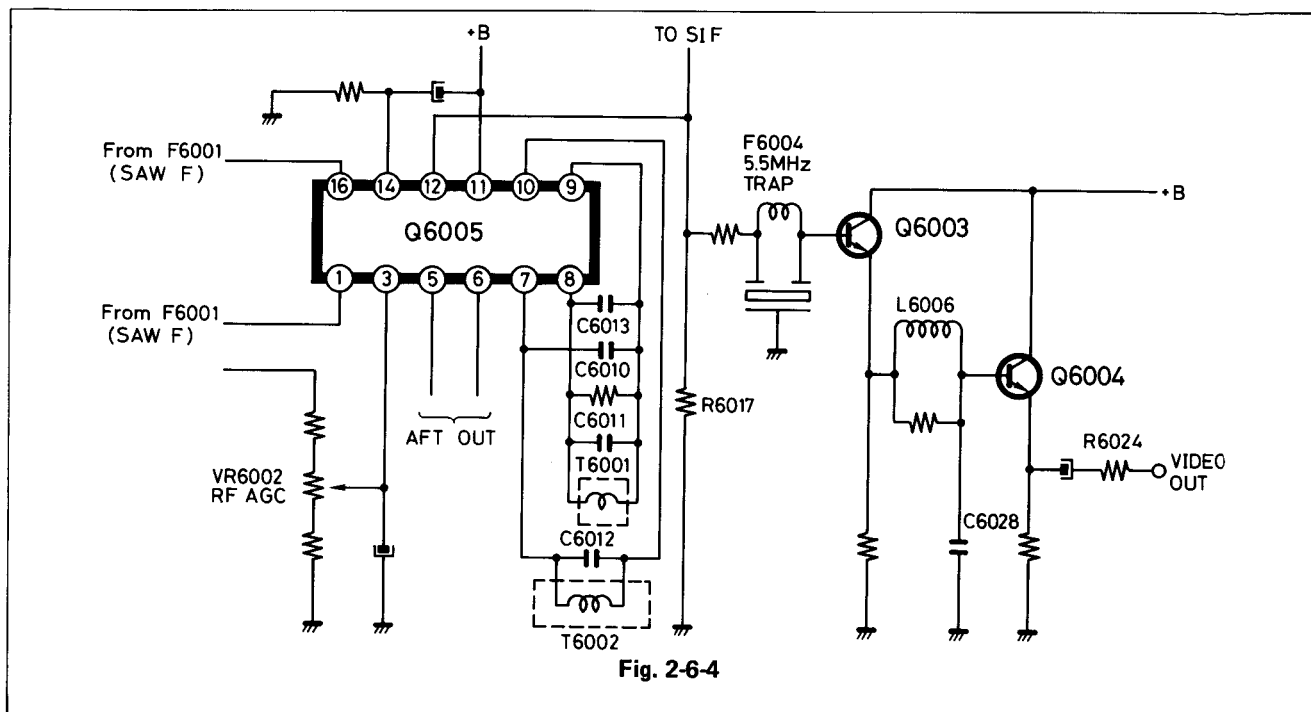
(3) AFT circuit

This circuit is composed of T6002 and C6012, and includes a phase shifter. The carrier output of the sync detector is connected to the phase shifter and the phase is detected, and therefore, a DC voltage which is proportional to the VIF carrier is obtained.

(4) AGC circuit

The AGC circuit is required to maintain the video output at a constant level in respect to fluctuations in the antenna input voltage. The control takes the form of a peak AGC system. The synchronizing signal level of the video





signal is detected, and the gain of the VIF amplifier circuit is varied, so that the level is maintained at a fixed value. The AGC voltage is also supplied to the U/V tuner's RF amplifiers of the UHF/VHF tuner, and the gain is varied (RF AGC-reverse AGC). When the antenna input voltage is low, the RF AGC action ceases and the RF amplifier functions at maximum gain. Once the input voltage exceeds approximately 65 dB μ , VR1 is set so that operation begins.

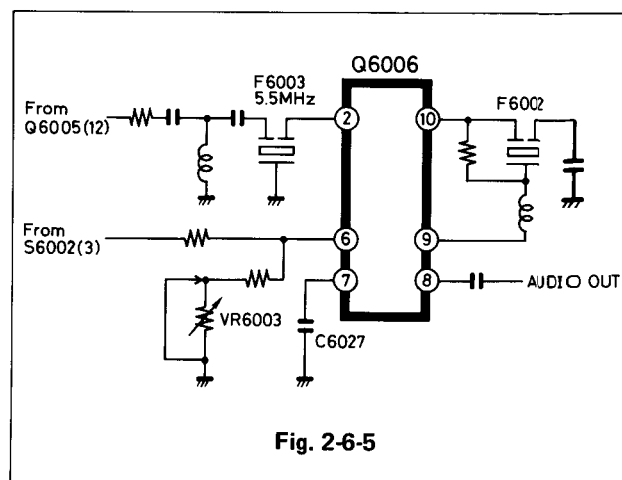
c. Video amplifier circuit

The level of the video signal detected by Q6005 is set by R6024 so that a 1 Vp-p output is obtained at the video output connector (75-ohm termination). The SIF signal contained in the video signal is eliminated by the ceramic trap F6004. Because the level of the video signal detected by Q6005 in the vicinity of the chrominance signal (4.43 MHz) is attenuated, the frequency response is smoothed by the L6006 and C6028 tuning circuit. Finally, the impedance is reduced by the emitter follower and R6024 is applied to set the output impedance to 75 ohms.

C. SIF CIRCUIT

The SIF signal which is contained in the video signal detected by Q6005 is removed by the ceramic filter F6003 and supplied to Q6006. Q6006 is composed of an amplitude-limiter circuit and an FM detector circuit. The SIF signal has its AM component removed by the amplitude-limiter circuit. The signal is then fed into the differential peak detector circuit, and the sound signal is produced.

The sound signal, which has undergone pre-emphasis at the transmission end, now undergoes de-emphasis by



C6027 and the internal impedance, and the frequency response is smoothed. The audio output level is adjusted by VR6003.

D. MUTING CIRCUIT

In the playback mode, both the video signal and the audio signal from the tuner circuit are designed to develop no output in order to prevent interference between the playback signal and the demodulated tuner signal. For this purpose, a voltage forcibly applied to Q6005 at pin (14) increases the AGC voltage for the IF amplifier, which then mutes the video signal output and the SIF signal output.

If there is no broadcast signal entering the tuner, or if the tuning is completely misaligned, and there is no video output, a high voltage will enter pin (3) of S6002, and the audio portion will be muted.

E. VARACTOR TUNING OPERATION

The new VCR model Colour Video Cassette Recorder features a varactor tuning system. The purpose of the varactor tuner is to provide electronic tuning without the use of mechanical tuners. The varactor tuner outputs switching potential to the tuners and a variable tuning voltage to the varactors in the UHF/VHF tuners. The unit has 8 channel selection pushbuttons. Each position can be tuned to any UHF (21 ~ 69) or VHF (2 ~ 12) channel. Once each channel has been preset accurately for reception of the desired broadcasting station, all that the viewer is required to do is simply press the channel button which corresponds to the desired channel. Thus, channel selection can be accomplished instantly.

The tuning and channel selection circuits built into a majority of VCR units depend upon mechanical operation to a varying extent. This means the conventional tuning systems are not free from mechanical malfunctions (due to worn contact points, etc.) which lead to service calls. In this varactor tuning system all mechanically operated parts have been replaced by 8 channel selection push-

button. Moreover, since channel selection is non-sequential, changing from one channel to another is instantaneously accomplished by pressing the desired pushbutton. The varactor tuning system should extend the service life of the VCR itself, while also increasing its reliability. The circuitry of the varactor tuning system can be broken down into the following three main blocks. (Refer to Fig. 2-6-6.) The following diagram indicates how these three main blocks are inter-related.

(1) Block 1

Push-tuning selectors and channel indicators utilizing LEDs (light emitting diodes).

(2) Block 2

Channel preset assembly consisting of the fine tuning control and the band selectors, which is preset to tune in the desired VHF and UHF stations.

(3) Block 3

UHF-VHF tuning assembly, where the main function of the varactor tuning system is performed.

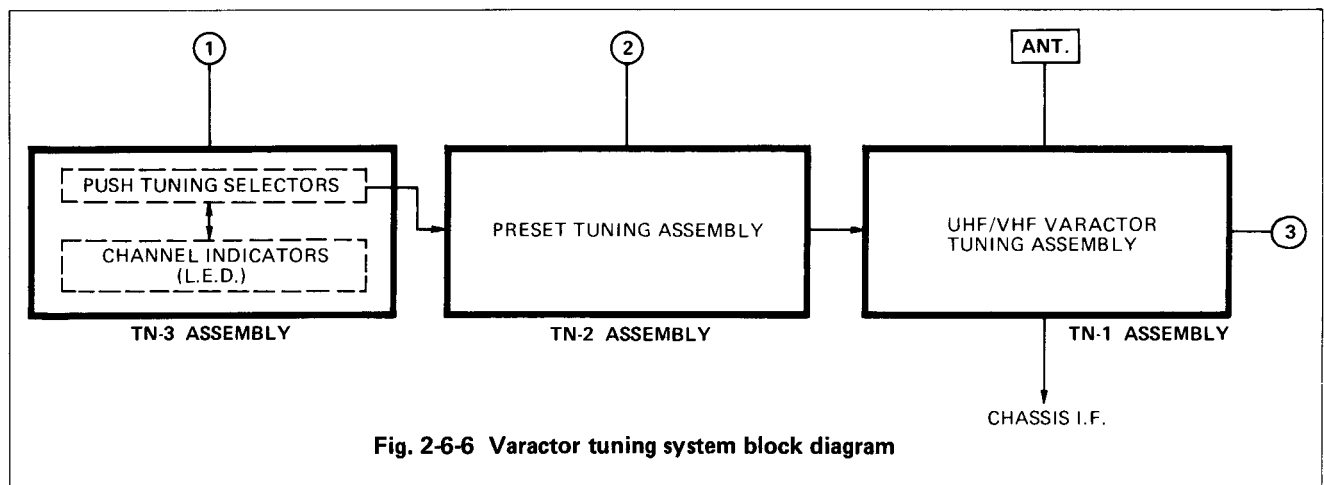


Fig. 2-6-6 Varactor tuning system block diagram

The VCR model is equipped with reliable pushbutton operation. The circuit can be described as: the push-buttons of TN-3 ↔ the tuning control of TN-2.

By turning the tuning control [(A) of VR6201], which should be preset to the desired channels, the resistance of VR6201 changes, thus controlling the amount of conduction of Q6201 through D6215 and VR6201. The voltage at the emitter of Q6201 is applied to the varactor tuner as tuning voltage. There are eight identical channel selection circuits as shown in Fig. 2-6-7. The channel selection pushbutton selects the desired circuit (channel), and also causes the corresponding channel indicator LED to illuminate.

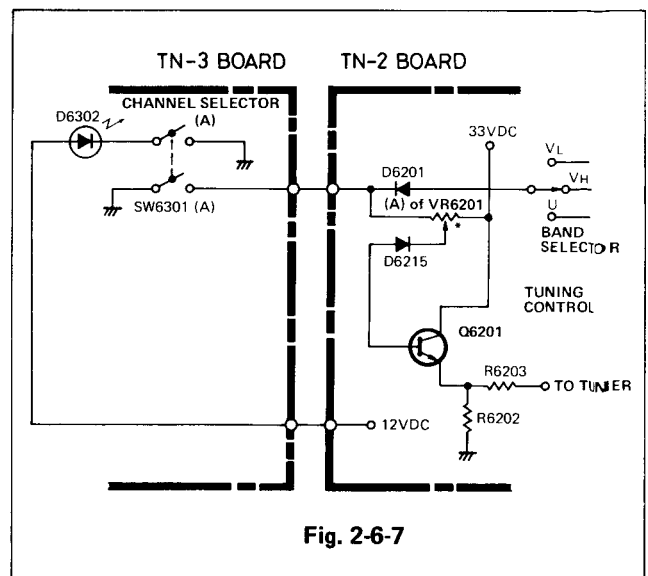
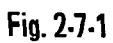


Fig. 2-6-7

simply transform and two circuit boards the AC power

simply circuit (PW-1 circuit board) A block diagram of

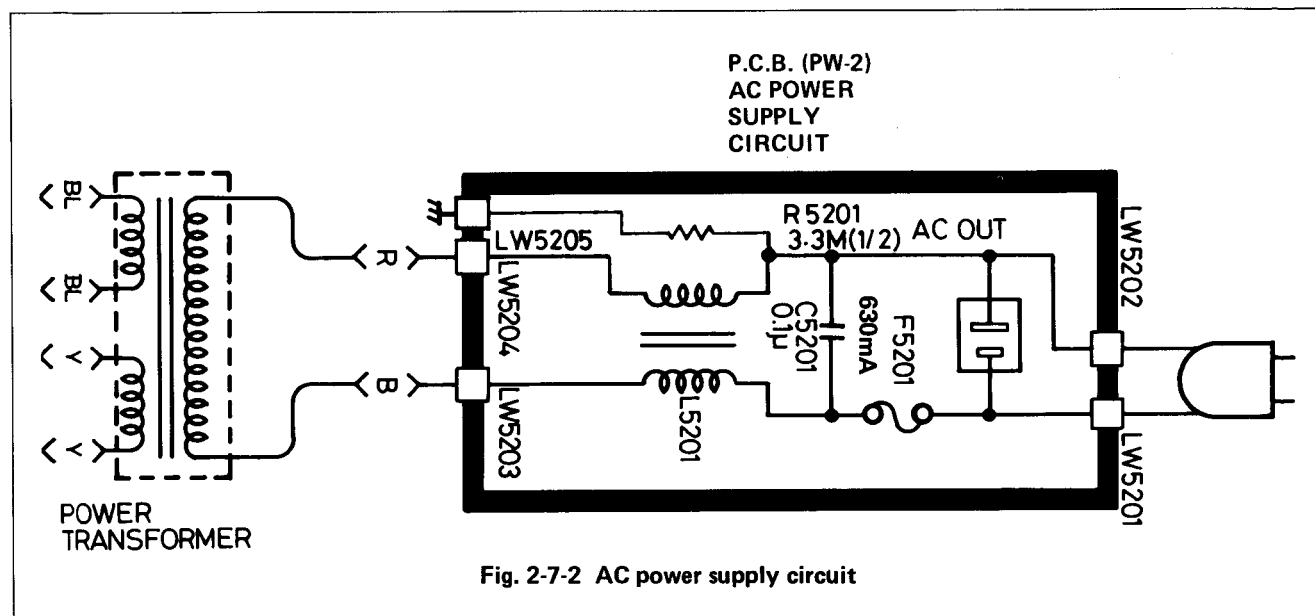
the power supply circuit is shown in Fig. 2-7-1.



2. AC Power Supply Circuit (PW-2 Circuit Board)

AC 220 V 50 Hz is input from the power cord to the PW-2 circuit board. This power supply passes through fuse

F5201 (630 mA) and the line filter which is composed of C5201 and L5201, and is then connected to the power supply transformer by LW5203 and LW5204.



3. DC-DC Converter Constant Voltage Circuit (PW-1 Circuit Board)

The DC-DC converter constant voltage circuit has a DC +12 V output circuit and a DC +15 V output circuit. Because the circuit composition of both circuits is essentially the same, only the DC +12 V output will be explained herein. The DC-DC converter constant voltage circuit outputs REG +12 V through a frequency-fixing pulse-width modulation system step-down switching regulator. Next, a simple explanation of the circuit operation will be given.

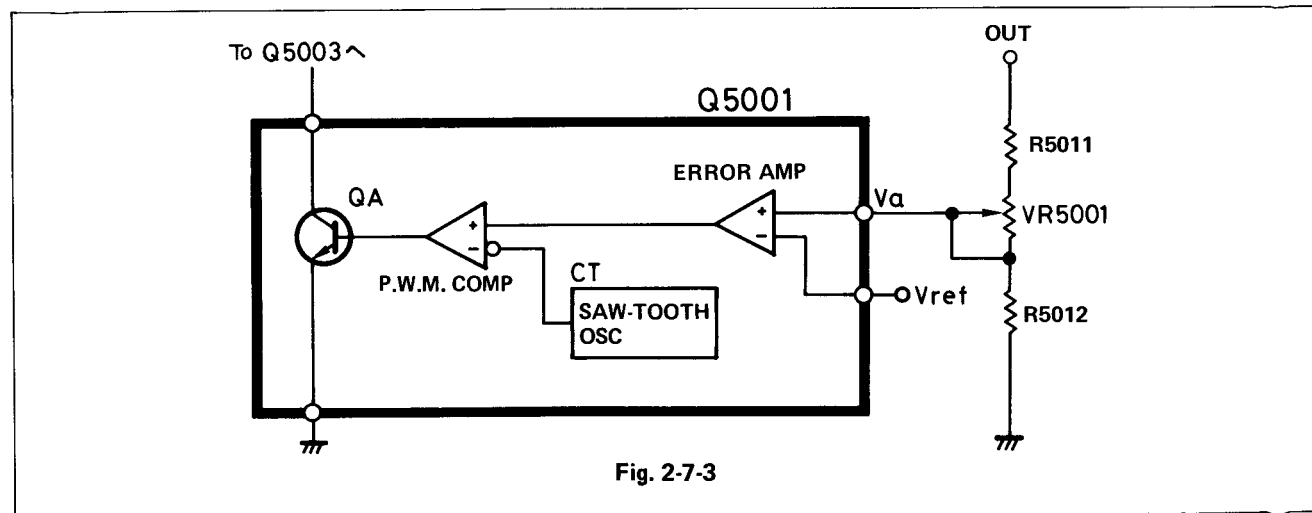
The control IC Q5001 controls the main transistor Q5003 at the oscillated switching frequency (21 kHz) through C5013 and R5027. The DC voltage is pulsed by Q5003, and passes through a filter composed of L5001 and

C5007, and is supplied to the load.

While Q5003 is ON, the current flows to the load through L5001 and C5007; when Q5003 switches OFF, the energy stored in L5001 passes through the closed circuit composed of D5003 (1/2), and the current is supplied to the load. Accordingly, the current which flows to L5003 becomes a triangular wave; however, in order to absorb the alternating current through C5007, the direct current is supplied to the load.

As stated previously, the DC voltage is supplied to the load; however, the control IC for stabilization of the output voltage is Q5001 (the frequency-fixing pulse-width modulation system switching regulator power supply control IC). (Refer to Fig. 2-7-3.)

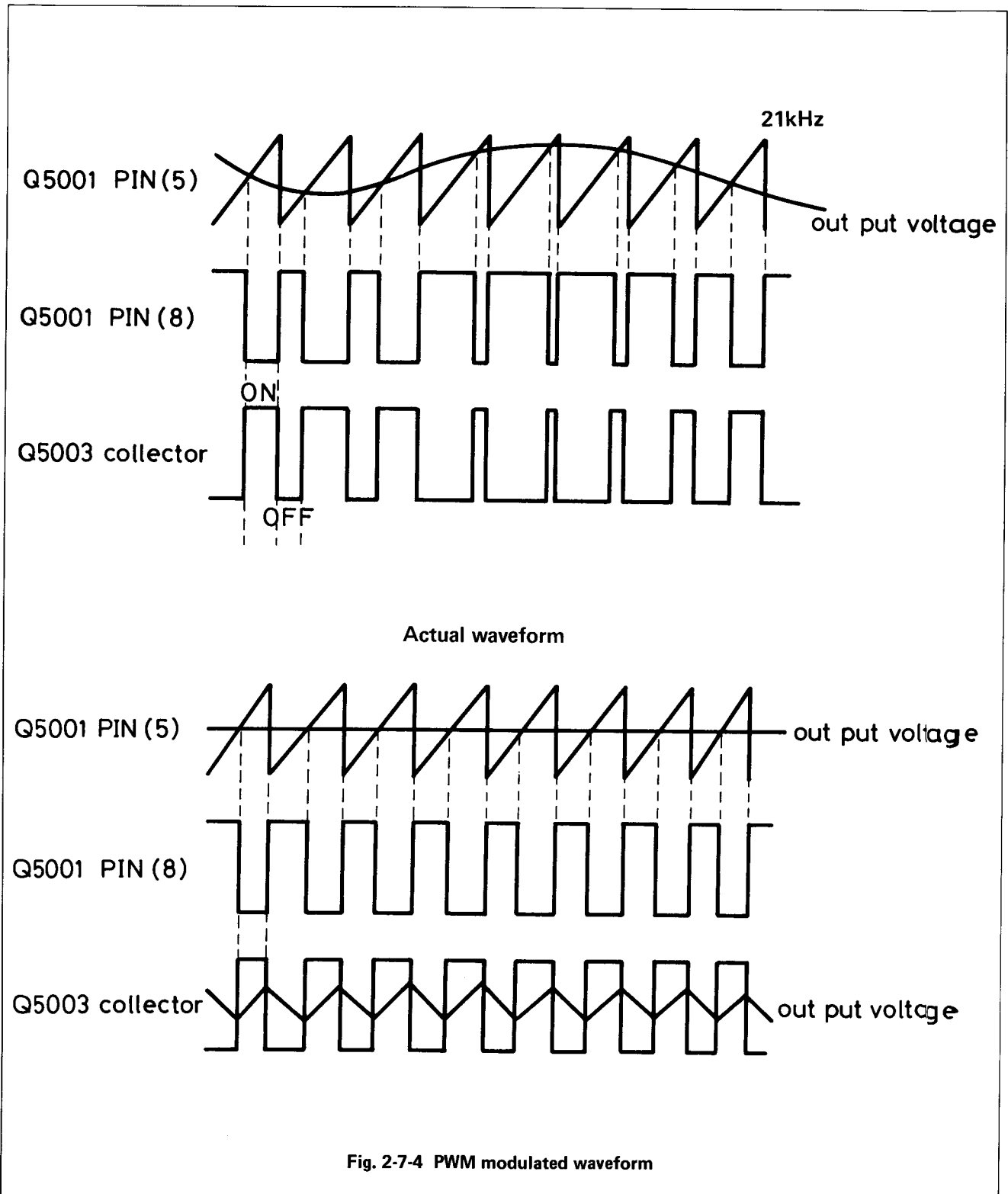
The fluctuation V_a of the output voltage is detected by



R5011, R5012, and VR5001, and is input to pin (1) of Q5001. Also, the +5 V output from pin (14), which is the internal reference of Q5001 used for voltage comparison, is voltage divided by R5013 and R5014, and then input to pin (2) of Q5001. The voltage fluctuation, which was input to pin (1) of Q5001 and compared with the reference voltage of pin (2), is amplified by the error amplifier

located within Q5001. The amplified fluctuation is input to the internal comparator of Q5001. Here, a saw-tooth wave is added to the input of the comparator, both of these are compared, the pulse width modulation (PWM) is output from the internal transistor of Q5001, and the constant output (REG +12 V) is obtained.

The modulated wave is shown in Fig. 2-7-4.

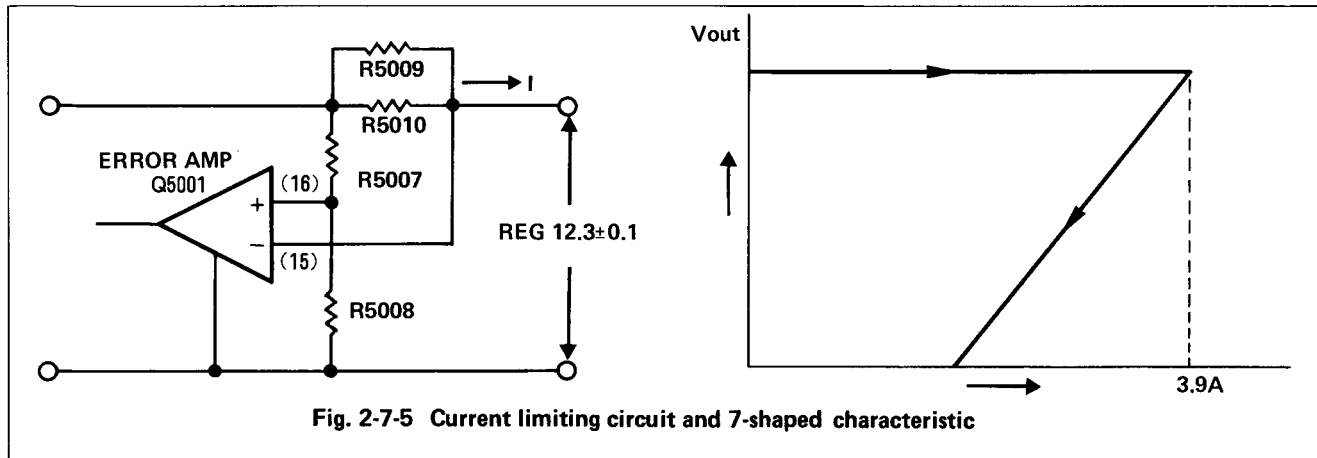


4. Protection Circuits

a. Current overload protection circuit

There is another error amplifier in Q5001, and this is utilized to perform current limiting. R5009 and R5010 of Fig. 2-7-5 are detection resistors. When the voltage drop at both ends of R5009 is equivalent to the voltage at both ends of R5007, current limiting is done. When

current limiting begins, the output voltage begins to drop, and, because of this, the voltage at both ends of R5007 decreases. In order to maintain this current limiting, the current output falls, and the voltage drop at both ends of R5009 also decreases. This condition can be visually represented by the 7-shaped characteristic shown in Fig. 2-7-5.



b. Voltage overload protection circuit

As shown in Fig. 2-7-6, a zener diode (D5004) is located at the output edge, and, if a voltage higher than the zener voltage of the zener diode appears at the output edge, the fuse (F5001) opens and a voltage overload is prevented.

5. +9 V Output Regulator Circuit

This circuit is composed of a series down system regulator circuit which receives a +12 V input and outputs +9 V. The +9 V output regulator circuit is shown in Fig. 2-7-7.

6. Switching Circuit (+12 V Output: ON/OFF)

The switching circuit is shown in Fig. 2-7-8, and the power switch operation table is shown in Table 2-7-1.

a. When the power switch is ON:

The base current flows through R5018 to Q5009, Q5009

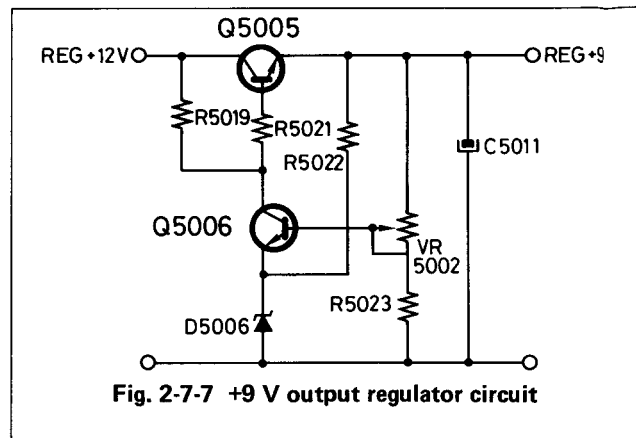
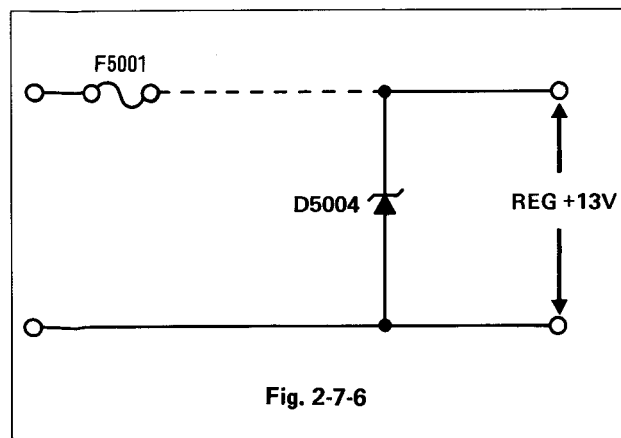
switches ON, and Q5007 switches OFF. As a result, the "dead-time" terminal of Q5001 is earthed, the dead time becomes 3% smaller, the output flows, and the VCR becomes ON.

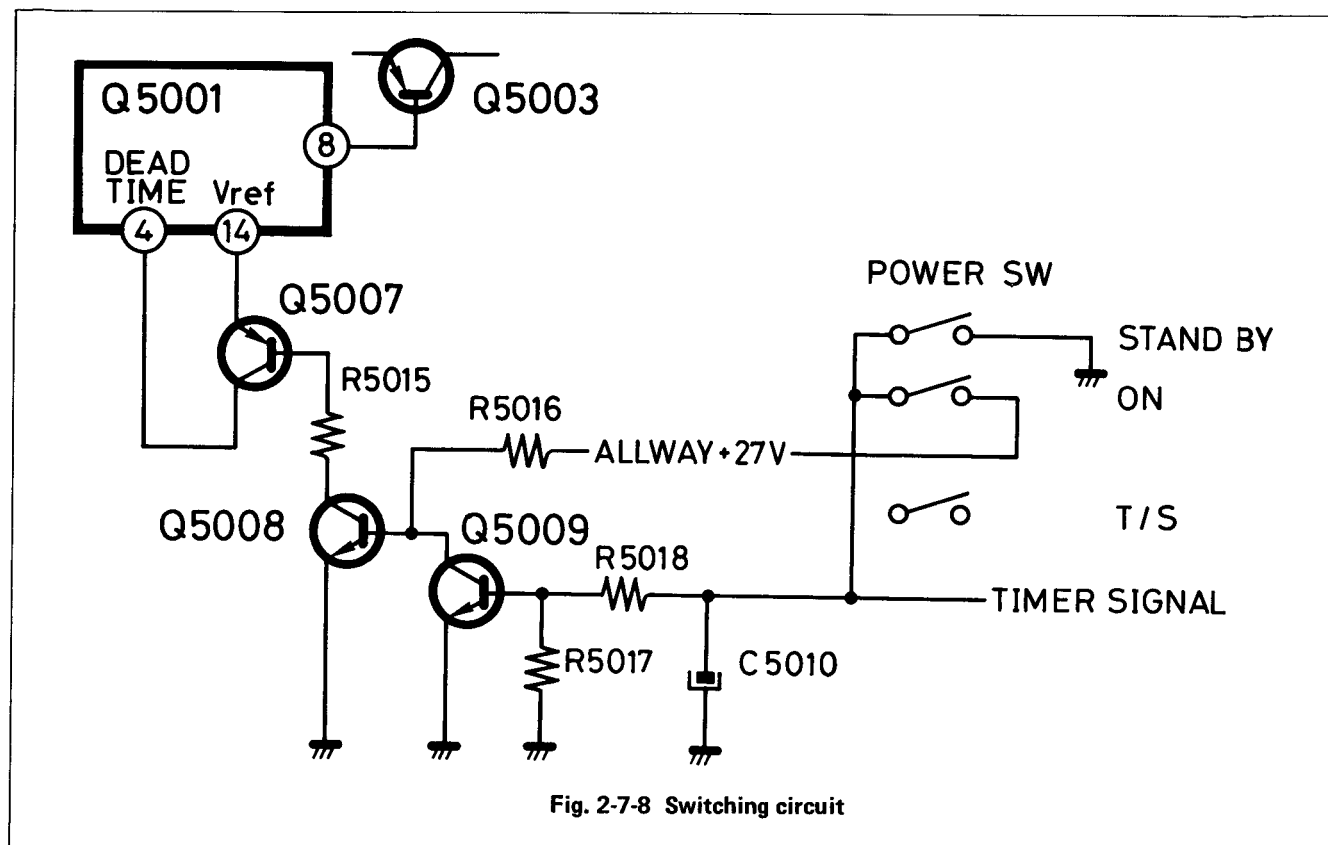
b. When the power switch is in the standby state:

Because the base of Q5009 is earthed, Q5009 switches OFF. The base current flows through R5016 to Q5008, causing it to switch ON. Because of this, the "dead-time" terminal of Q5001 becomes 5 V, the dead time becomes approximately 100%, Q5003 switches OFF, the output does not flow, and the VCR becomes OFF.

c. When the power switch is in the timer state:

If the power switch is at the timer side, Q5009, in accordance with the timer signal, switches ON or OFF, and, simultaneously with the switching ON and OFF of the power switch, the power is switched ON or OFF.





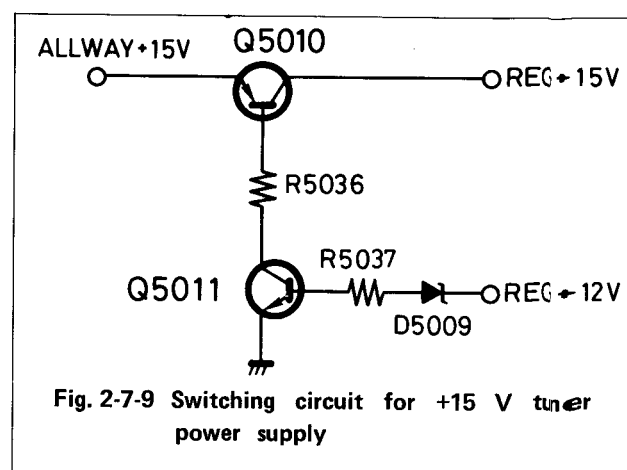
POWER SW. MODE		Q5009	Q5008	Q5007	Pin (4) of Q5001	Constant voltage circuit operation
ON		ON	OFF	OFF	H	15 V, 12 V, 9 V, all circuits ON
STAND BY		OFF	ON	ON	L	12 V, 9 V, circuit OFF
T/S	TIMER H	ON	OFF	OFF	H	All circuits ON
	TIMER L	OFF	ON	ON	L	12 V, 9 V, circuit OFF

Table 2-7-1 Switching circuit operation

7. Switching Circuit for +15 V Tuner Power Supply

Because the +15 V tuner power supply, just as the +12 V and +9 V output circuits, must be output when the power switch is in the standby state, a switching circuit is necessary.

As shown in Fig. 2-7-9, while REG +12 V is input to the base of Q5011, Q5011 is ON; furthermore, Q5010 switches ON (saturated), and +15 V is supplied to the tuner circuit. Also, if the power switch is in the standby state, +12 V is not input to the base of Q5011, and, therefore, both Q5011 and Q5010 switch OFF, and +15 V is not supplied to the tuner circuit.



8. Power Supply Destinations and Voltages

CIRCUIT SUPPLY VOLTAGE	VIDEO	SYSTEM CONTROL	SERVO	TUNER	TIMER	RECONVERTE
All way + 33V				○		
All way + 15V					○	
All way + 12V						○
All way AC2.4V					○	
REG + 15V				○		
REG + 12V	○	○	○	○		
REG + 9V	○	○				

Table 2-7-2

IX. MECHANISM DESCRIPTION

A. FEATURES

1. Mechanism Chassis

The chassis which form the base for the mechanism are constructed as follows:

a. Drum chassis (main chassis)

This chassis is constructed of die-cast aluminium, and is mainly for mounting the tape path system and the video head drum.

b. Reel chassis (sub chassis)

this chassis is constructed of glass-fiber-strengthened plastic, and is mainly for mounting the reel drive system, the loading drive system, and the eject mechanism. It is mounted on the drum chassis (main chassis).

2. Motor and Solenoid Structure

The motors and solenoids (three motors and three solenoids) which drive the mechanism consist of the following:

a. Head motor

- * Brushless DC motor.
- * Direct drive (D.D.) system built into the video head drum.

b. Capstan motor

- * Brushless DC motor.
- * Capstan-integrated direct drive (D.D.) system.

c. Reel motor

- * DC motor.
- * Reel base and loading drive by belts and gears.
- * Combined loading motor.

d. Pinch roller pressure solenoid

- * Pinch roller pressure operation.
- * Reel base brake release operation.

e. Fast forward/rewind solenoid

- * Speed reduction mechanism and clutch switching operation.
- * Reel base brake release operation.

f. EJECT solenoid

- * Eject operation.

Mode	Video head motor	Capstan motor	Reel motor	Pinch-roller pressure solenoid	Fast forward/rewind solenoid	Reel base speed	Eject solenoid
LOADING	ON	OFF	ON; CW	OFF	OFF	—	OFF
STOP	OFF	OFF	OFF	OFF	OFF	—	OFF
PLAY, FWD, REC	ON	ON; ACW	ON; CW	ON	OFF	LOW	OFF
F FWD	ON	OFF	ON; CW	OFF	ON	HIGH	OFF
REW	ON	OFF	ON; ACW	OFF	ON	HIGH	OFF
EJECT	ON	OFF	ON; ACW	OFF	ON	HIGH	OFF

CW: Clockwise

AW: Anti-clockwise

Table 3-3-1

3. Mechanism Operation

The handling of the switching of the mechanism in each mode is carried out by a combination of solenoid operation together with capstan motor and reel motor operation.

- (a) Switching of the idler gear to the supply reel base of the reel base drive, or to the take-up reel base, is performed by the rotation force and rotation direction of the reel motor.
- (b) The idler gear is moved up and down by the fast forward/ rewind solenoid, and carries out slip-mechanism switching of the reel base drive reduction ratio for playback tape motion.
- (c) For loading and unloading, the loading ring is driven by the power of the reel motor through belts and gears.
- (d) For cassette-up operation, the eject roller is pressed against the capstan motor by the operation of the eject solenoid, and the mechanism is switched to the CASSETTE-UP mode by the power of the capstan motor.

B. SAFETY DEVICES

1. Tape End Detection Device (Refer to Fig. 3-2-1.)

Video cassette tape has "trailer tape" made of nonmagnetic material at both ends of the magnetic tape. The

tape end is detected when the forward sensor or the reverse sensor senses this trailer tape. (Refer to section IV, SYSTEM CONTROL CIRCUIT.) As outlined below, each mode is changed to the REW mode or STOP mode by the signal output from Q3005 (LA7011; SY-1 system control circuit) of the tape end sensor circuit.

a. Detection of tape end by the forward sensor

(1) PLAY and REC modes

The pinch roller pressure solenoid (1) is released, and the brakes (supply reel brake and take-up reel brake) (2) are engaged. The fast forward/rewind solenoid (3) is then engaged, and the VCR is set to the REW mode.

(2) F FWD mode

The fast forward/rewind solenoid (3) is released, and the brakes (supply reel brake and take up reel brake) (2) are engaged. The idler year (4) is then switched by the fast forward/rewind solenoid (3), and the VCR is set to REW mode.

b. Detection of tape end by the reverse sensor

(1) REW mode

The fast forward/rewind solenoid (3) is released, the brakes (supply reel brake and take-up reel brake) (2) are engaged, and the VCR is set to the STOP mode.

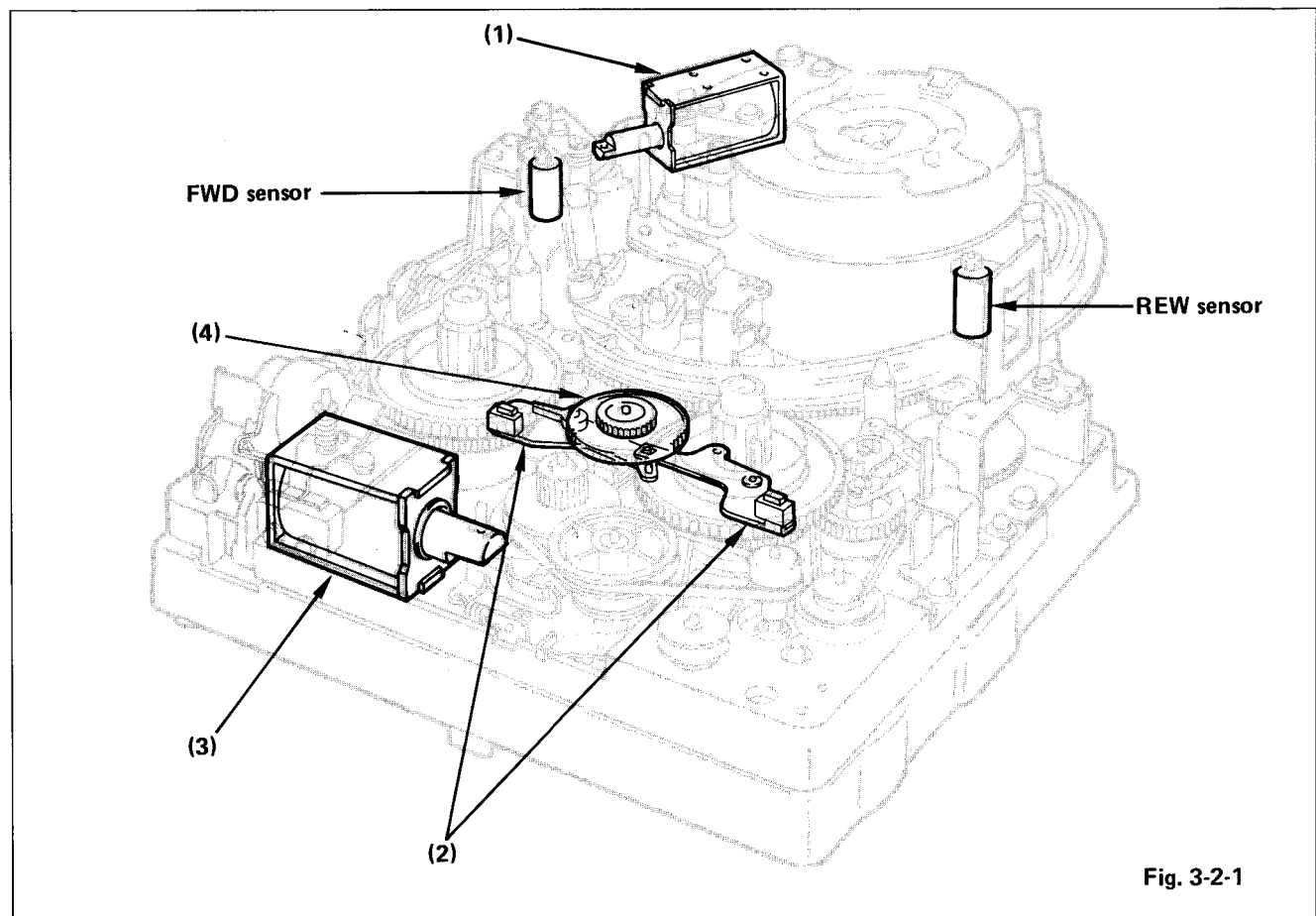


Fig. 3-2-1

2. Dew Sensing Device (Refer to Fig. 3-2-2)

If the temperature or humidity changes sharply, condensation or moisture may form on the surface of the drum. If this happens, the dew sensor detects the moisture condensation, the pinch-roller pressure solenoid (1), or the fast forward/rewind solenoid (3), is released, the

brakes (2) are engaged, and the VCR is set to the STOP mode. By setting the VCR to the STOP mode, damage to the tape and mechanism is prevented. When the dew sensor operates, an LED illuminates. At this time no mode can be operated except CASSETTE-UP.

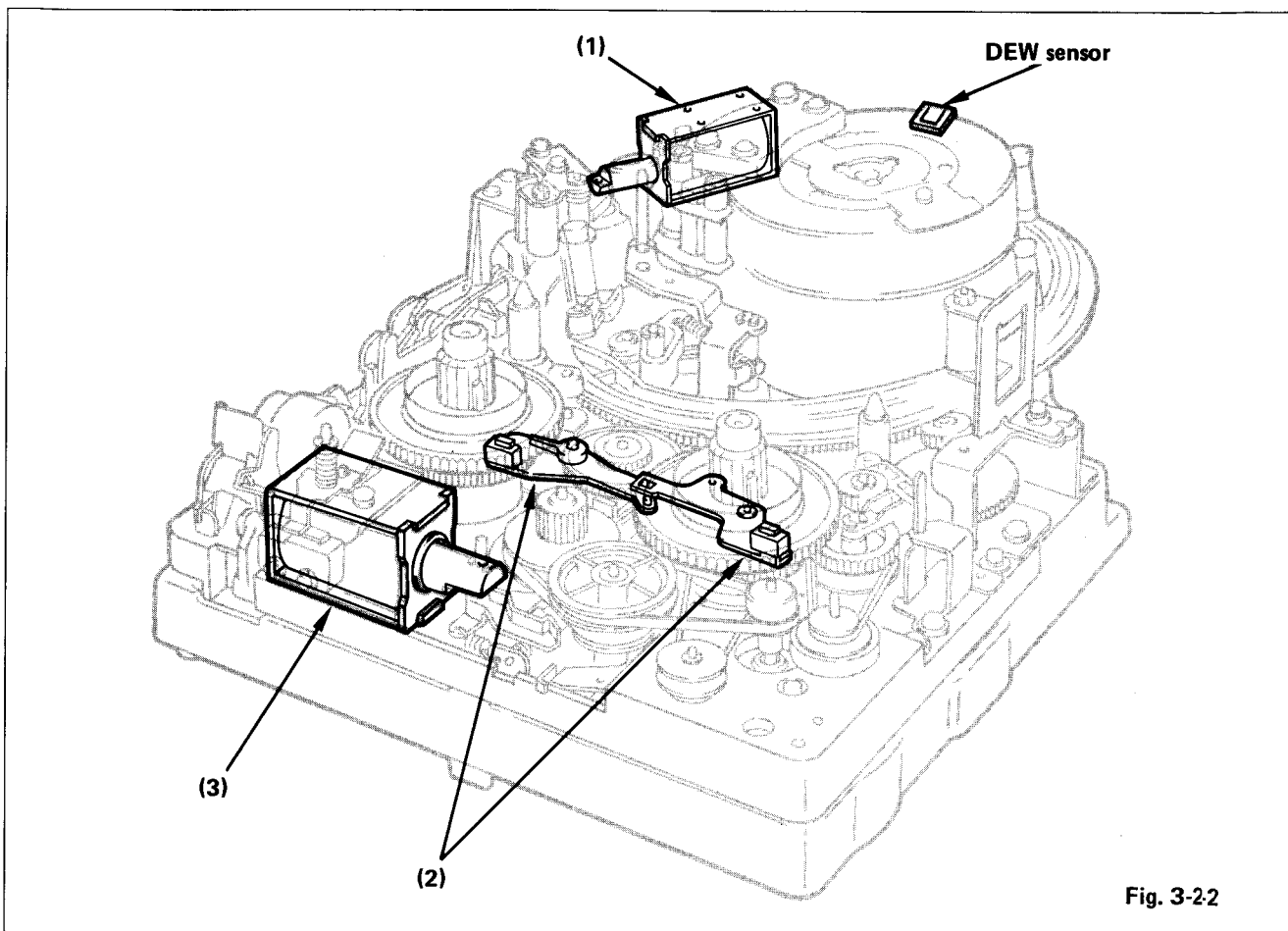


Fig. 3-22

3. Take-Up Reel Base Rotation Sensing Device (Refer to Fig. 3-2-3.)

In every mode except PAUSE, damage to the reel motor, or severing of the belt, will cause the take-up reel base to stop, which could cause the tape to become slack, thus damaging the tape. In order to prevent this, a detection mechanism, composed of a magnet (2) attached to the tape counter (1) and a magnetic reluctance element (3) positioned nearby, senses the rotation of the take-up reel base. When the take-up reel base rotates, the rotation is transferred to the tape counter (1) through the belt (4), and the magnet (2) gives a pulse-like signal to the magnetic reluctance element (3).

If the take-up reel base stops, because this signal becomes constant (refer to section IV, SYSTEM CONTROL CIRCUIT), the stopping of the take-up reel base is detected, and the unit automatically switches to the STOP mode, thus stopping the tape travel and preventing damage to the tape.

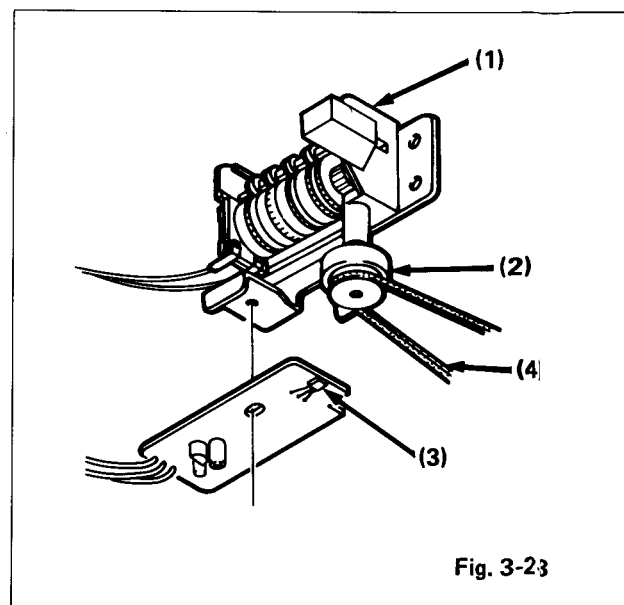


Fig. 3-23

C. MECHANISM OPERATION IN EACH MODE

1. From Cassette Insertion to Loading Completion (Refer to Figs. 3-3-1 ~ 3-3-5.)

With the POWER ON button in the pressed position during the period between cassette insertion and completion of cassette loading, when the cassette is inserted the lock on the cassette holder lid is released. When the cassette holder is pushed down, the lid is opened by the

cassette lid guide (1). As the cassette descends, the cassette detection lever (2) is pushed down, and the cassette holder is locked by the cassette holder lock lever (3), and, at the same time, the cassette switch (4) is switched ON. At that time, the loading stopper release slide (5) moves in the direction indicated by the arrow, and the loading ring lock lever (6) is released. (Refer to Figs. 3-3-1 and 3-3-2.)

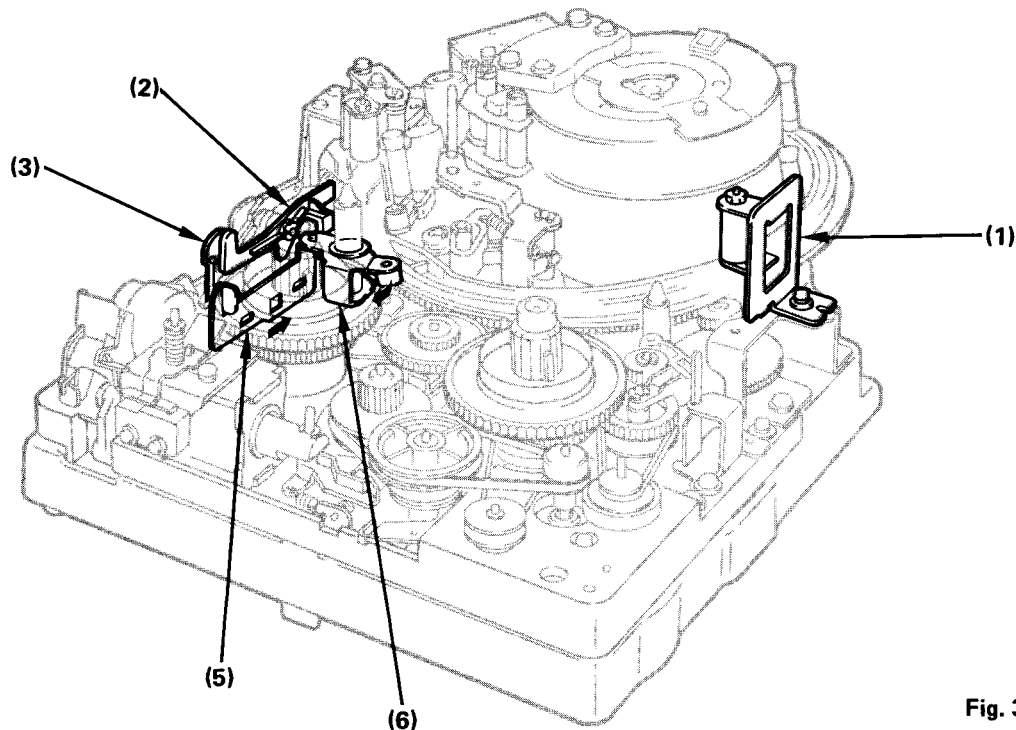


Fig. 3-3-1

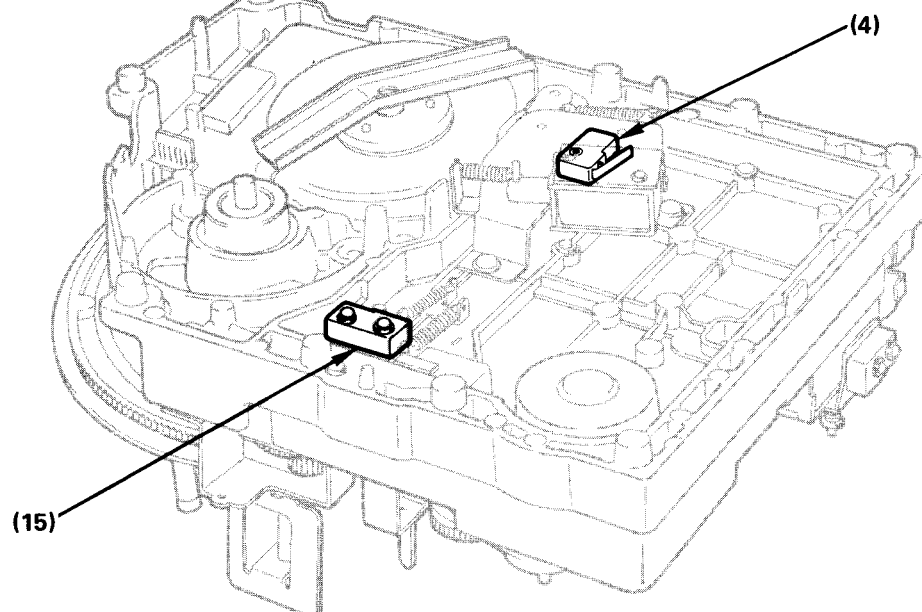


Fig 3-3-2

When the cassette switch (4) is switched ON, the reel motor (7) rotates in the anti-clockwise direction, and the loading roller (9), which is pressed against the reel motor pulley (8), rotates. The rotation of the loading roller (9) is conveyed to the loading ring (10) by a belt and gears, and the loading ring (10) begins to rotate in the anti-clockwise direction. The supply reel brake (12) and the take-up reel brake (13) are released by the loading end lever (11), which moves in the direction indicated by the arrow at the beginning of loading ring rotation. (Refer to Fig. 3-3-3.)

The cassette tape is pulled out by the guides of the loading ring (10), and is wound toward the erase head, video head drum, and audio/control head. Each part of the loading ring has a cam, and, when section A of the

cam reaches the position of the loading end roller (14), the loading end roller (14) enters into section A. In accordance with the movements of the loading end roller (14), at the same time as the loading ring (10) becomes locked, the loading roller (9) moves away from the reel motor pulley (8), and, furthermore, the loading end switch (15) is switched OFF, thus completing the LOADING mode. When loading is completed, the supply reel brake (12) and the take-up reel brake (13) are each pressed against the reel base. At the same time, the back tension operation lever (16) is rotated in the anti-clockwise direction by the B section of the loading ring (10) cam, and the back tension lever (17) is set. (Refer to Fig. 3-3-4 and Fig. 3-3-5.)

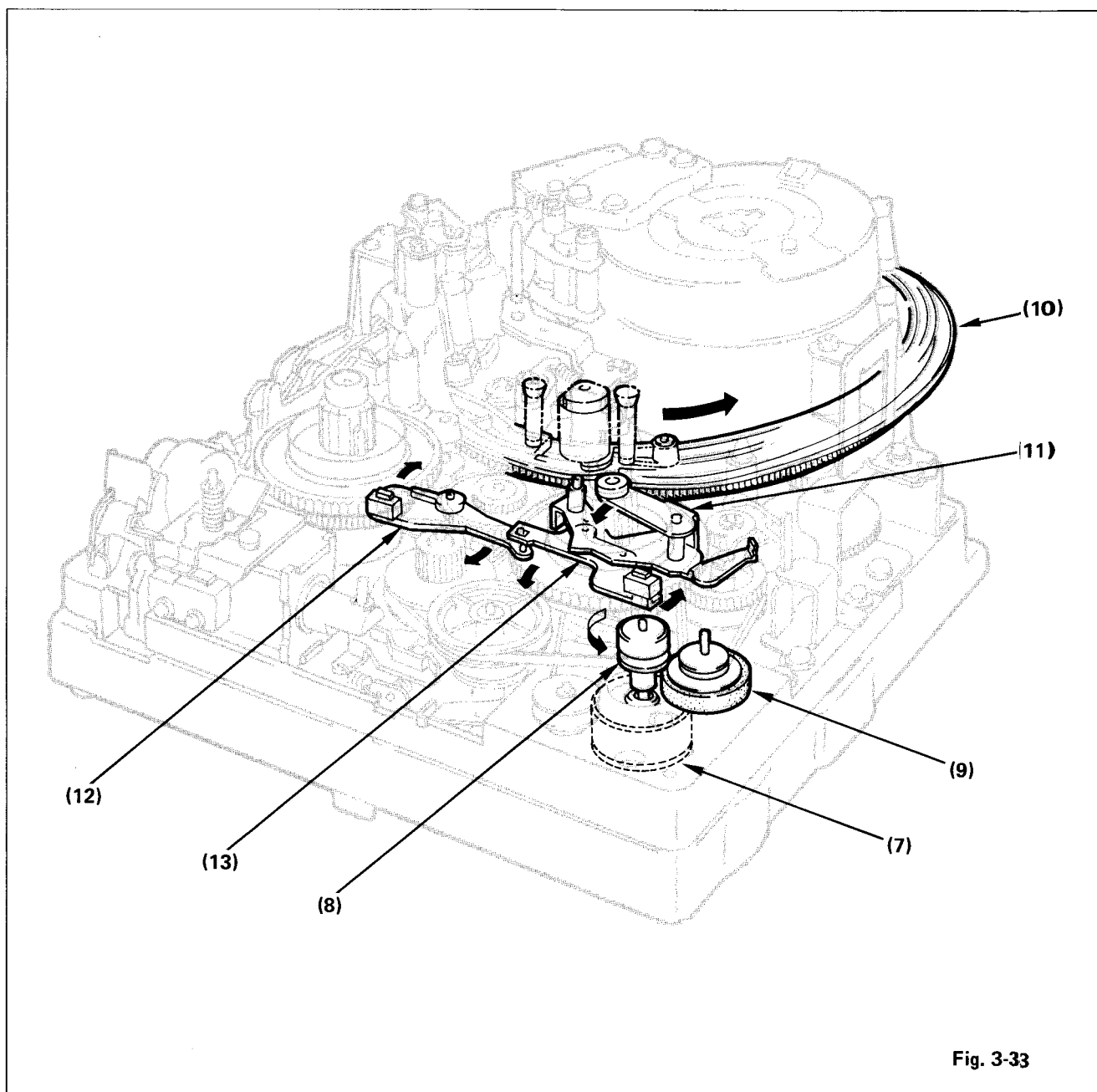


Fig. 3-33

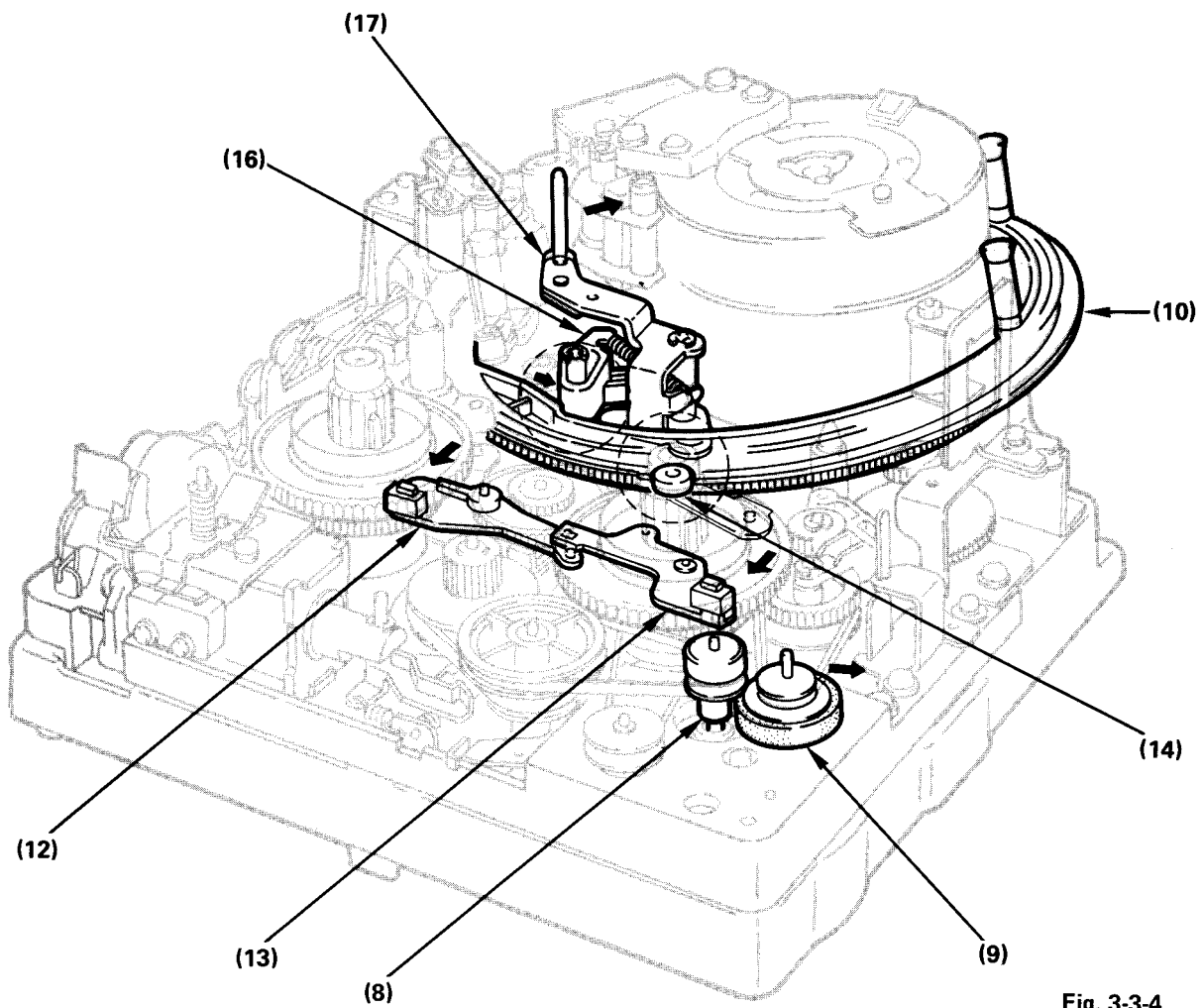
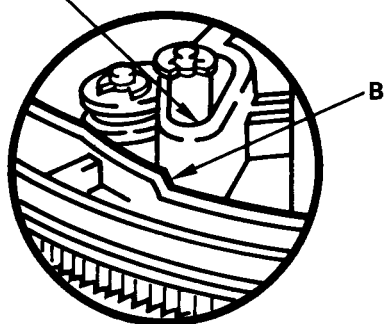
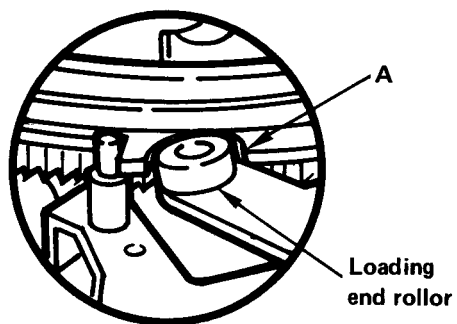


Fig. 3-3-4

Back tension
operation lever



Cam B



Cam A

Fig. 3-3-5

2. Drive Path and Switching Direction of the Reel Bases in Each Mode

Before giving the explanation for each mode, an overall explanation of the drive paths and switching direction of the reel bases will be given.

Tape travel is driven at a constant speed by the capstan. There are two types of take-up. One is take-up at the reel base through the slip mechanism, and the other is take-up performed directly at the reel base, without passing through the slip mechanism. If take-up direction is divided into the supply reel side and the take-up side, there are the following three drive paths.

a. Drive Path 1

Drive of the take-up reel through the slip mechanism (PLAY mode and REC mode).

b. Drive Path 2

Direct drive of the take-up reel (F FWD mode).

c. Drive Path 3

Direct drive of the supply reel (REW mode).

(1) Structure (Refer to Fig. 3-3-6 and Fig. 3-3-7.)

The reel drive paths are shown in Fig. 3-3-6 and Fig. 3-3-7. The idler gear (18) is installed on the idler support lever (19), and the idler support lever (19) can rock at its centre on the pivot (20). A centre gear (21) is installed on the pivot (20), and the centre gear (21) is driven by the second belt (23), through the relay pulley (22). The centre gear (21) is also engaged with the idler gear (18). The supply reel brake (12) and the take-up reel brake (13) at each reel base are engaged by the brake spring (24). The idler select lever (26), which supports the idler select link (25), is in contact with the C section of the supply reel brake (12). The spring coil (27) is hooked on the idler select lever (26), and always applies a anti-clockwise rotation force to the lever.

As for the idler select link (25), the long hole of the D section is in contact with the idler support lever (19).

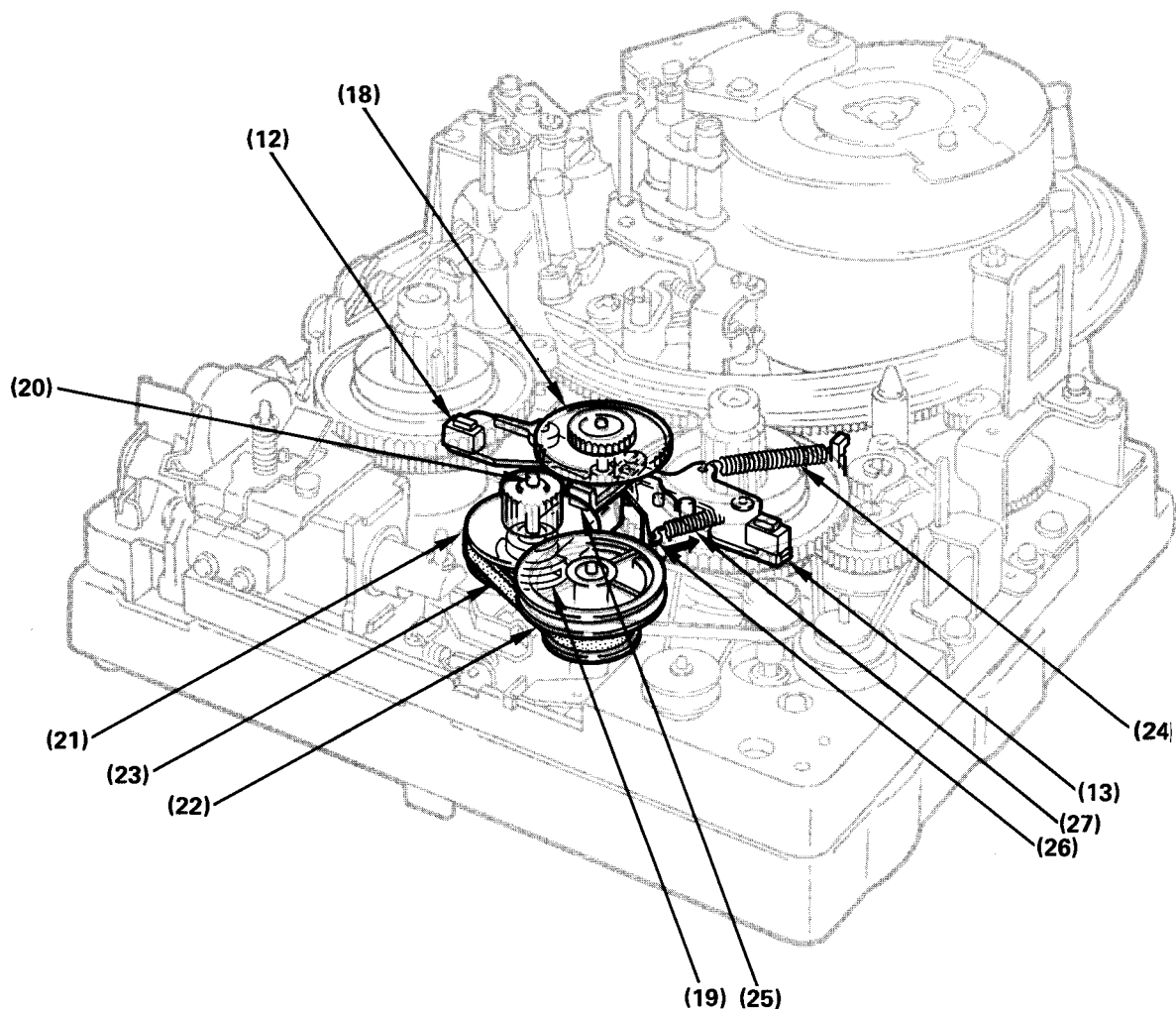


Fig. 3-3-6

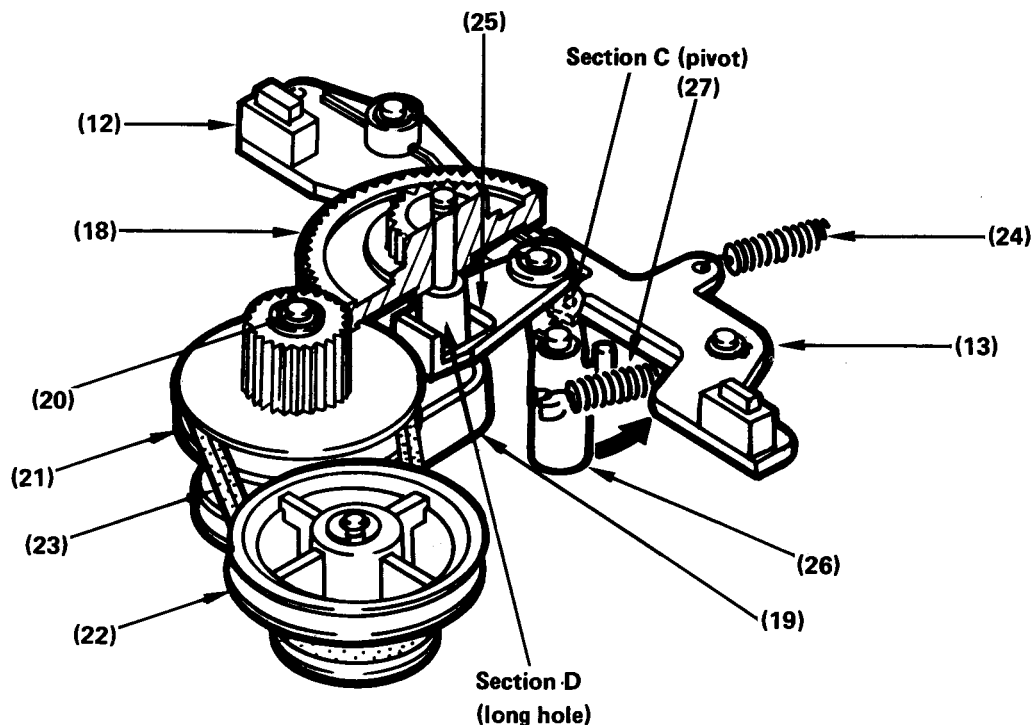


Fig. 3-3-7

(2) Operation (Refer to Figs. 3-3-8 ~ 3-3-12.)

Fig. 3-3-6 shows the conditions during the STOP mode, and, if from this state the supply reel brake (12) is released, the idler select lever (26) attempts to rotate anti-clockwise as shown in Fig. 3-3-8 and Fig. 3-3-9. Because of this, the tip of the idler select link (25), section E, is tightly connected to the second belt (23) looped around the centre gear (21). If the centre gear (21) rotates clockwise from this state, the idler select link (25) moves in the direction indicated by the arrow, and, therefore, the idler support lever (19) also moves clockwise. Until the idler select link (25) and the second belt (23) move away, when the idler support lever (19) rotates, it is rotated by the rotation force of the idler select lever (26) until it makes contact with the stopper (28). When it moves to this position, the idler gear (18) interlocks with the take-up reel gear (29).

In the same manner, if the rotation direction of the centre gear (21) is reversed, the idler gear (18) interlocks with the supply reel gear (30).

The above are the switching operations when winding the

cassette tape onto the supply reel or onto the take-up reel.

In the next section, the switching operations of the reel drive through the slip mechanism and of direct drive of the reel base are described.

As shown in Fig. 3-3-10, there are 2 gears each for the supply reel base and for the take-up reel base. When the upper gears are driven, it becomes a slip drive, and when the lower gears are driven, it becomes a direct drive. The vertical movement lever (31) is connected to the idler support lever (19); when the fast forward/rewind solenoid (32) is in the released state, section F of the idler gear (18) interlocks with the take-up reel slip gear (33); when the solenoid is activated, the idler support lever (19) and the idler gear (18) move downward, and section G and gear H interlock directly. (Refer to Fig. 3-3-11 and Fig. 3-3-12.)

As explained previously, reel drive paths 1 through 3 are switched by dividing the rotation direction and the height of the idler gear into two stages.

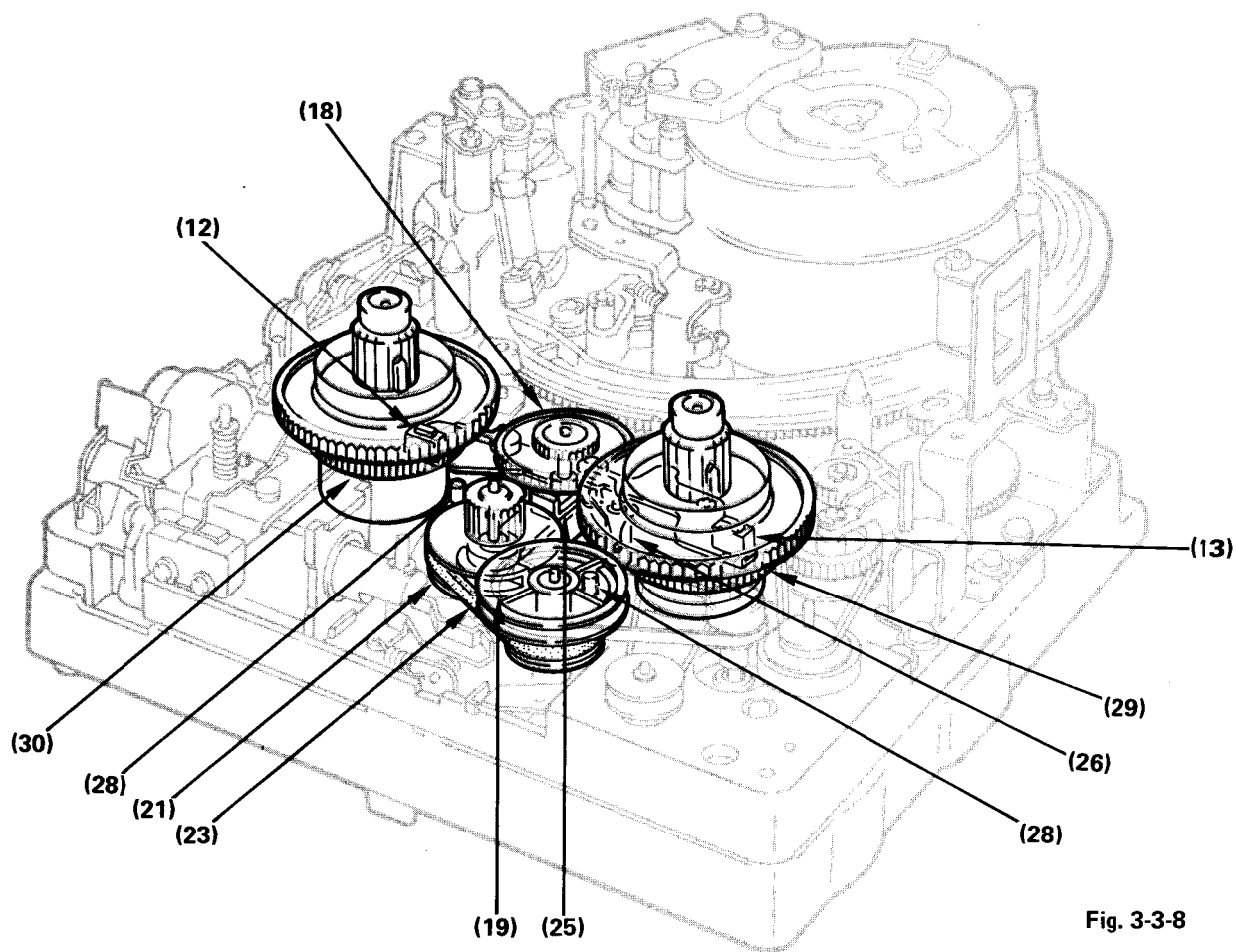


Fig. 3-3-8

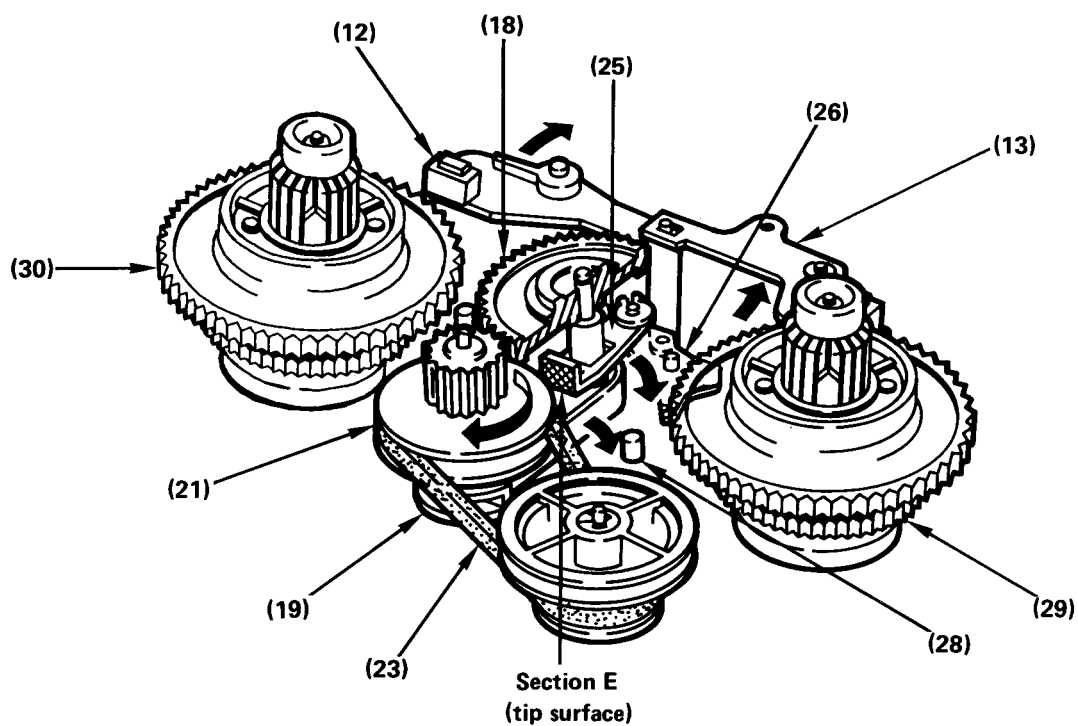


Fig. 3-3-9

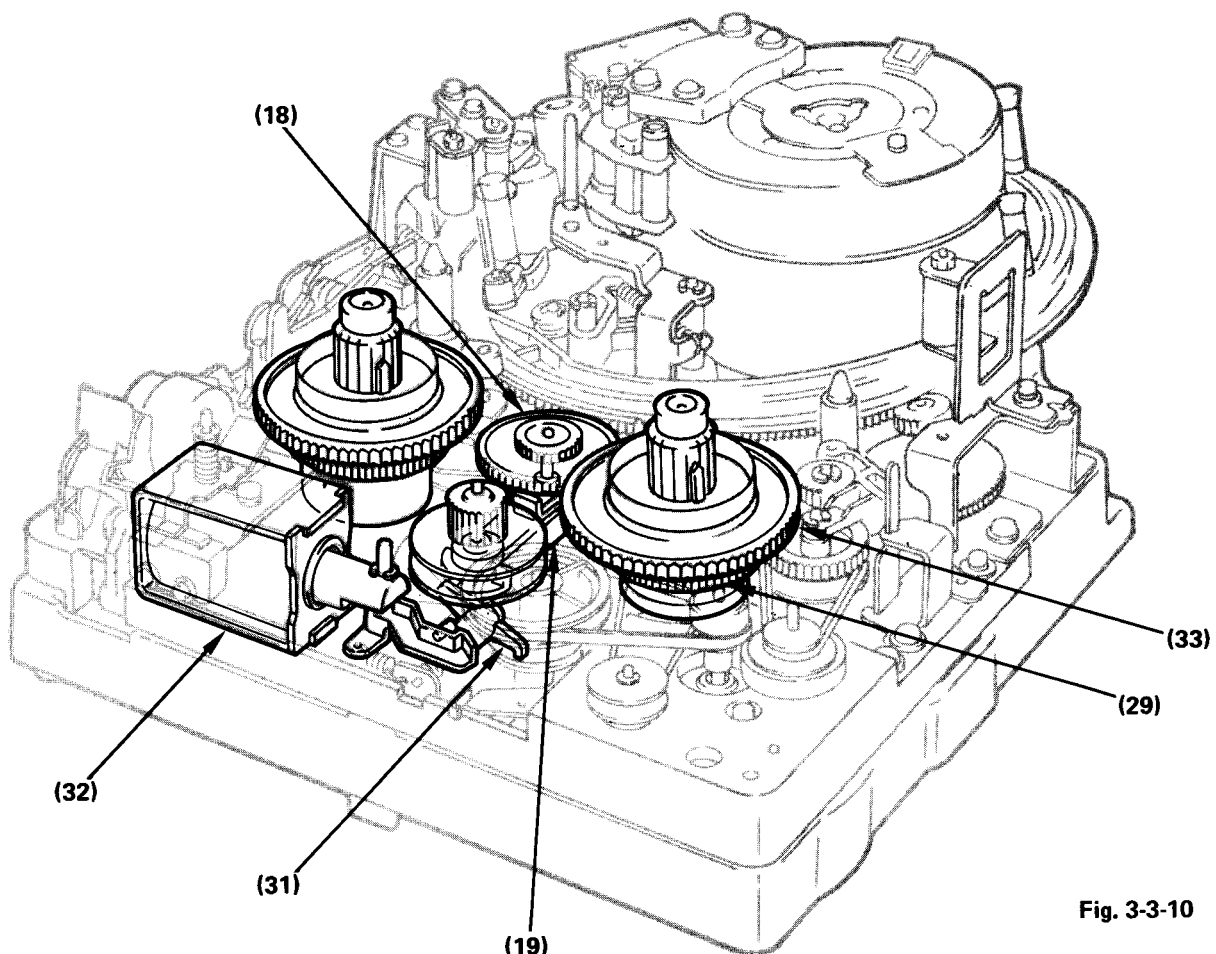


Fig. 3-3-10

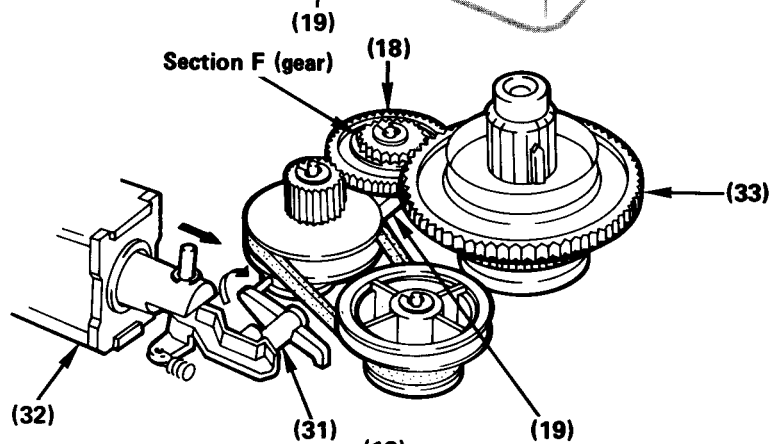


Fig. 3-3-11

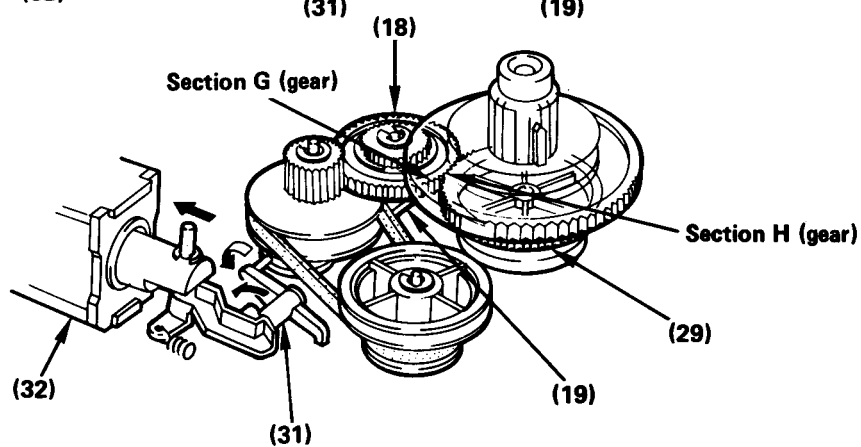


Fig 3-3-12

3. PLAY Mode (Refer to Fig. 3-3-13.)

- a. Press the PLAY button.
- b. The pinch roller pressure solenoid (34) is energized, the pinch roller pressure lever (35) turns in the direction indicated by the arrow, and the pinch roller (36) presses against the capstan (37).
- c. Due to the turning motion of the pinch roller pressure lever (35), the brake release lever (play) (38) and the play release brake slide (39) move in the directions indicated by their respective arrows.
- d. Due to the motion of the play release brake slide (39), the supply reel brake (12) and the take-up reel brake (13) are released.
- e. Due to the release of the supply reel brake (12), the idler gear (18) operates. (Refer to item C-2. "rive Path and Switching Direction of the Reel Bases in Each Mode".)
- f. The capstan turns, and tape movement begins.

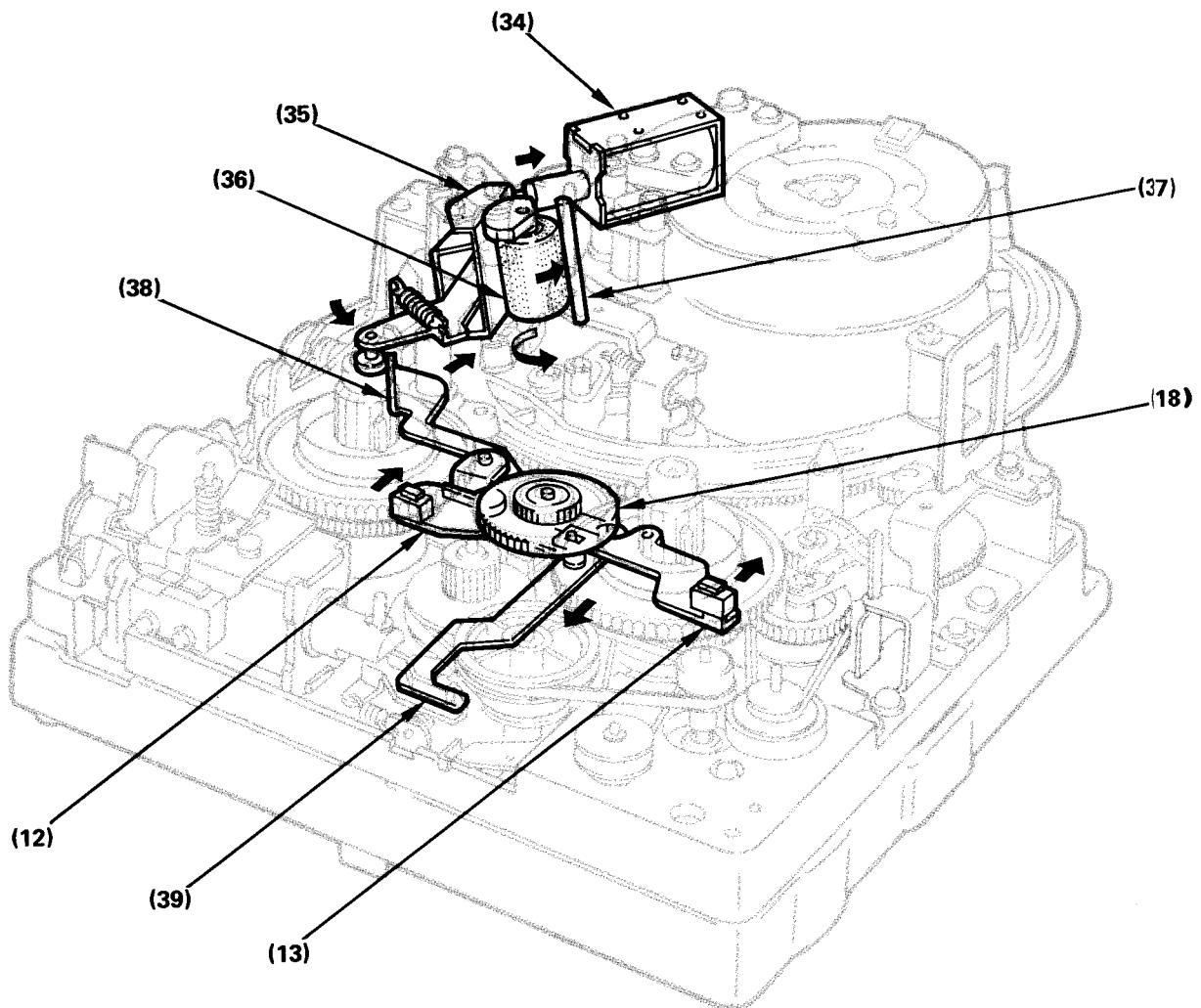


Fig. 3-3-1)

4. F FWD Mode (Refer to Fig. 3-3-14.)

- a. Press the F FWD button.
- b. The fast forward/rewind solenoid (32) is activated, the back tension lever (17) is pushed back, the brake release lever (fast forward/rewind) (42) is released, and then the take-up reel brake (13) is released.
- c. The reel motor pulley (8) turns clockwise, the idler gear (18) meshes with the take-up reel gear (29), and tape movement begins. (Refer to item C-2. "Drive Path and Switching Direction of the Reel Bases in Each Mode".)

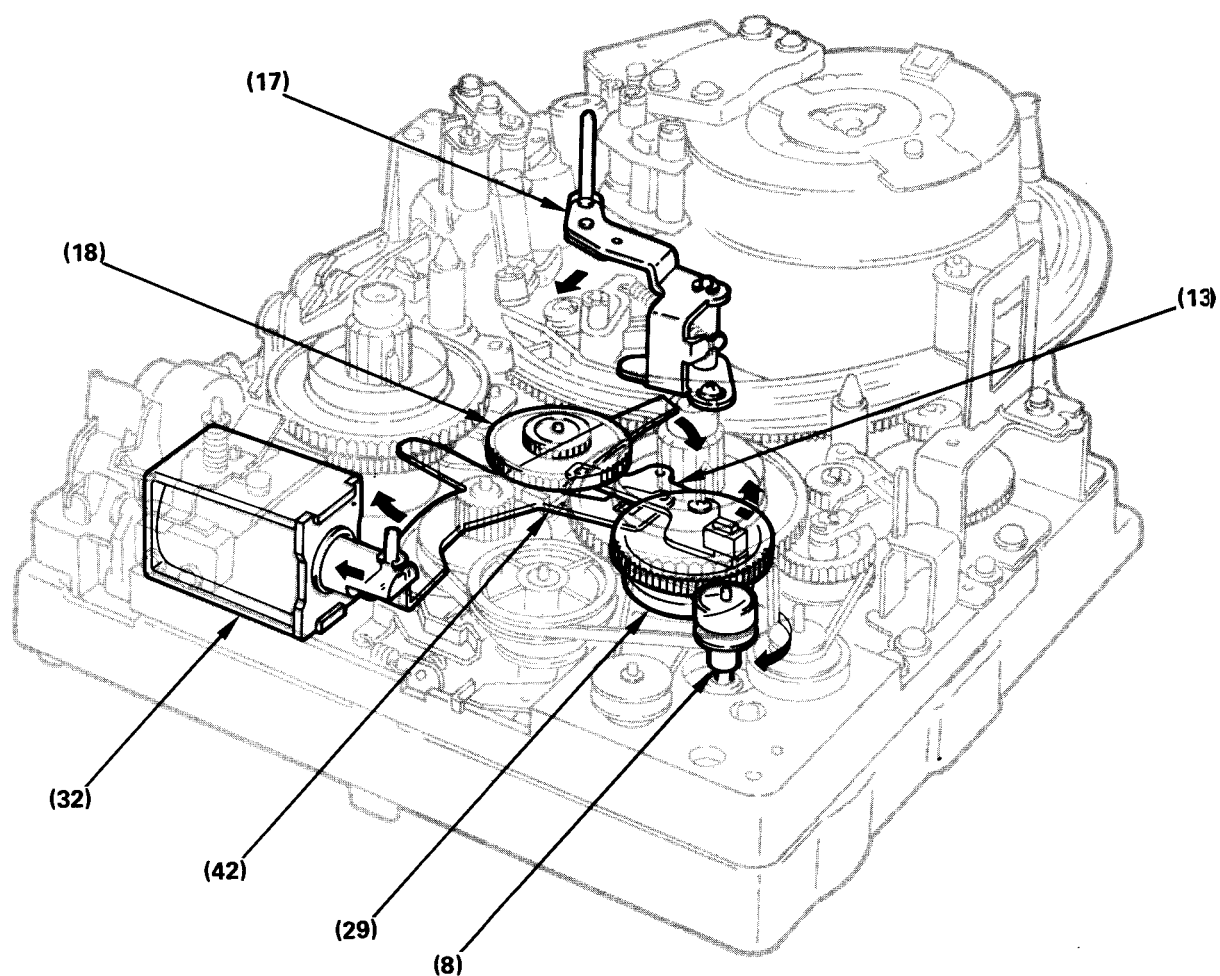


Fig. 3-3-14

5. REW Mode (Refer to Fig. 3-3-15.)

- a. Press the REW button.
- b. The fast forward/rewind solenoid (32) is activated. The back tension lever (17) is pushed back, the brake release lever (fast forward/rewind) (42) is released,

and then the supply reel brake (12) is released.

- c. The reel motor pulley (8) turns in the anti-clockwise direction, the idler gear (18) meshes with the supply reel gear (30), and tape movement begins.

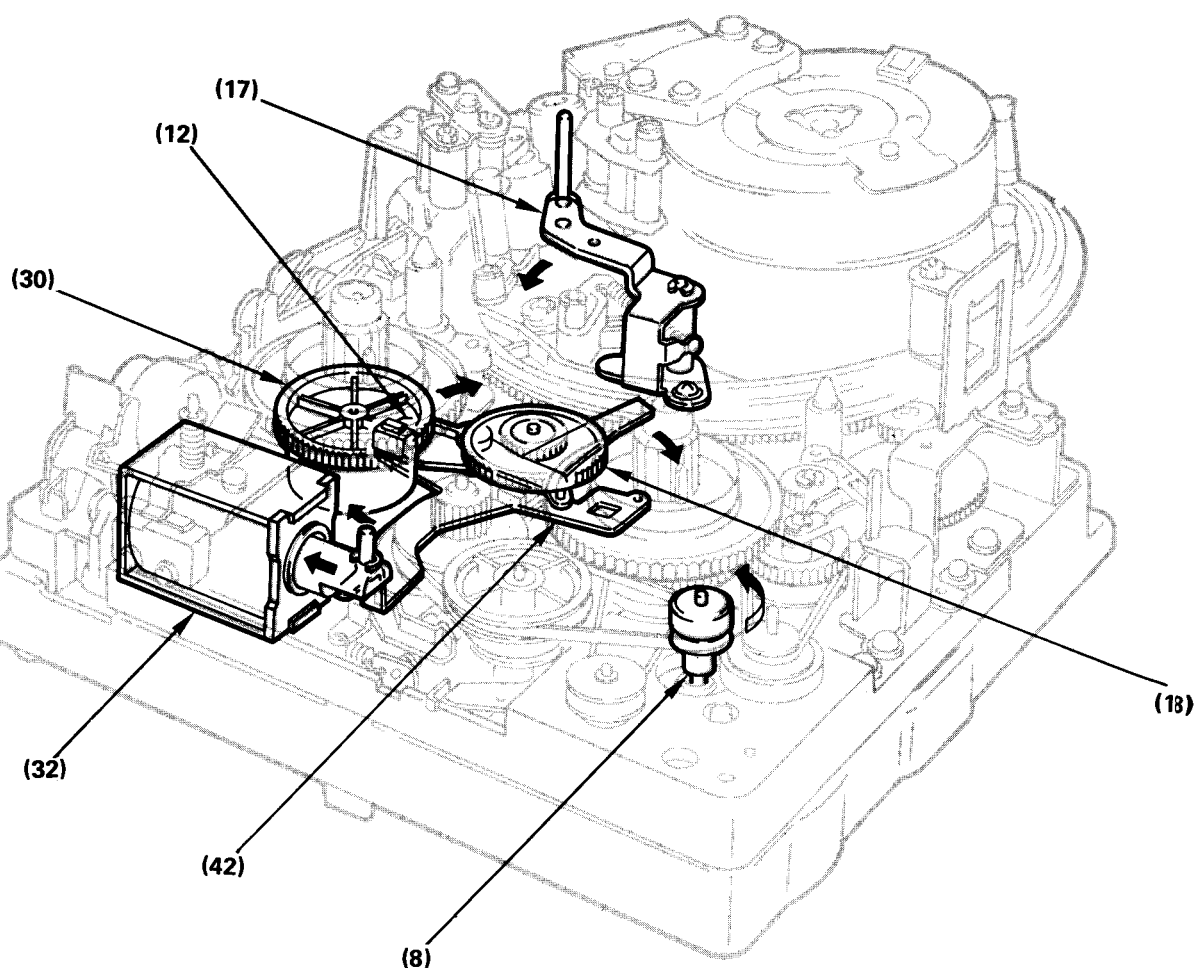


Fig. 3-3-15

6. REC Mode

- a. Press the REC button. The REC mode is only operative when the erasure prevention tab of the video cassette has not been removed.
- b. Mechanical operations are the same as during the PLAY mode. (Refer to item 3. "PLAY mode".)

7. PAUSE Mode (Refer to Fig. 3-3-16.)

- a. From the PLAY mode or the REC mode, press the PAUSE button.
- b. The pinch roller pressure solenoid (34) is released. The pinch roller (36) separates from the capstan (37), and, at the same time, the supply reel brake (12) and the take-up reel brake (13) are applied to each reel.
- c. Tape movement stops, and the tape is in a waiting condition; all motors, however, continue to rotate.

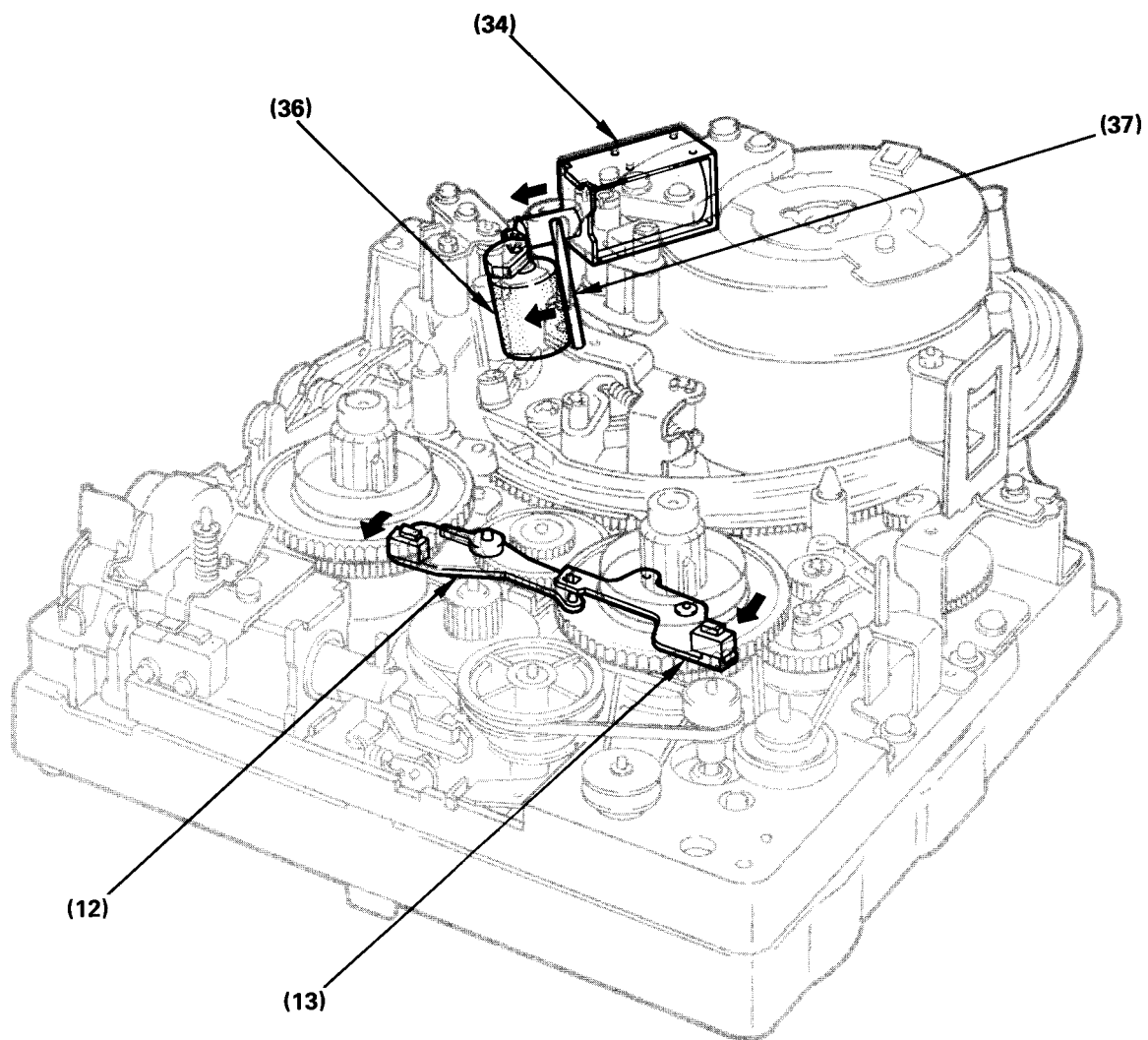


Fig. 3-3-16

8. CASSETTE-UP Mode (Refer to Figs. 3-3-17 ~ 3-3-19.)

- a. Press the EJECT button.
- b. The capstan flywheel (43) turns in the direction indicated by the arrow, and, at the same time, the eject solenoid (44) is activated, and the eject roller (45) puts pressure on the perimeter of the capstan flywheel (43). (Refer to Fig. 3-3-17.)
- c. The lever (46) moves the eject relay lever (47) in the direction indicated by the arrow. (Refer to Fig. 3-3-17.)

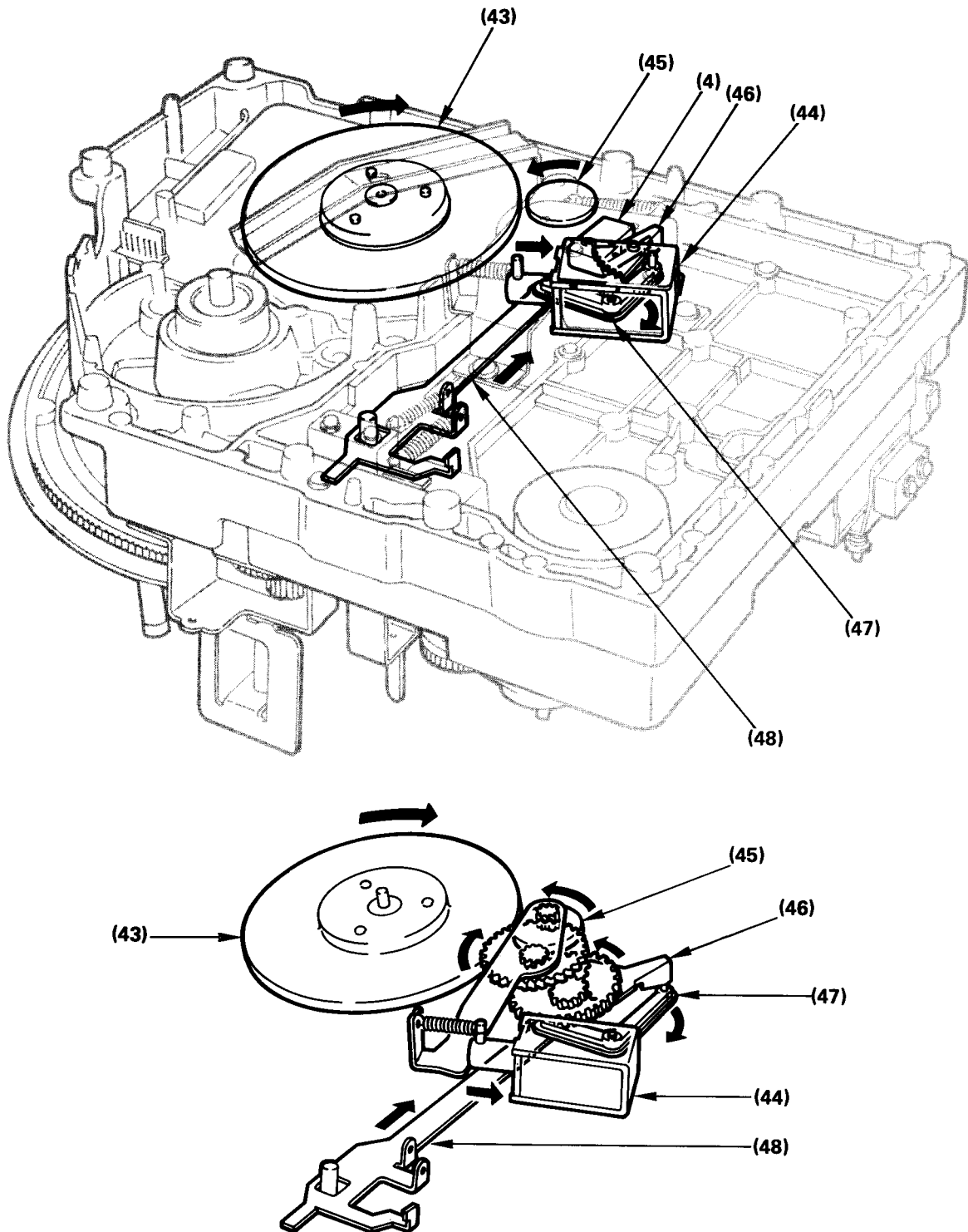


Fig. 3-3-7

d. The eject slide (48) moves with the eject relay lever (47) in the indicated direction, causing the loading end lever (11) to move, thereby breaking its connection to the loading ring (10). At the same time, the loading roller (9) puts pressure on the reel motor pulley (8). (Refer to Fig. 3-3-17 and Fig. 3-3-18.)

e. The eject lock lever (49) turns in the direction indicated by the arrow, holding the eject lever (50), and at the same time, eject switch II (51) switches ON. (Refer to Fig. 3-3-18.)

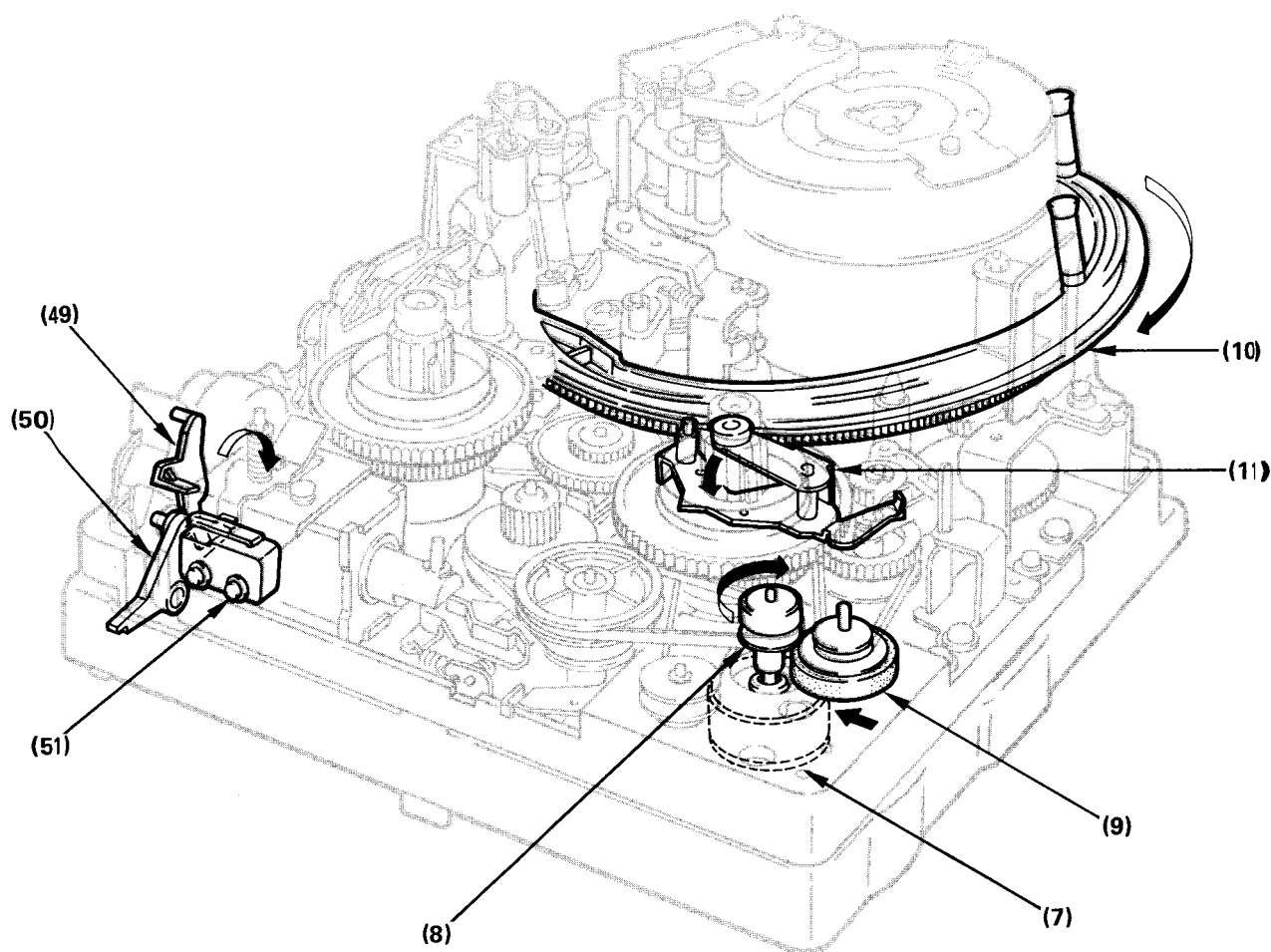


Fig. 3-3-18

- f. The reel motor (7) and the loading ring (10) rotate in the clockwise direction, and unloading begins. Also, the eject solenoid (44) is released. (Refer to Fig. 3-3-18.)
- g. At this time, the supply reel brake (12) and the take-up reel brake (13) are released, and the eject brake (52) is applied to the supply reel gear (30). (Refer to Fig. 3-3-19.)
- h. When unloading is completed, the loading ring lock roller (53) moves in the direction indicated by the arrow, into the I section, the loading ring lock lever (6) is released, and the cassette moves up. At this time, the cassette switch (4) switches OFF. (Refer to Fig. 3-3-17 and Fig. 3-3-19.)
- i. When the cassette holder is raised, the eject release lever (54) turns in the direction indicated by the arrow, the eject lock lever (49) is released, and the CASSETTE-UP mode is completed. (Refer to Fig. 3-3-19.)

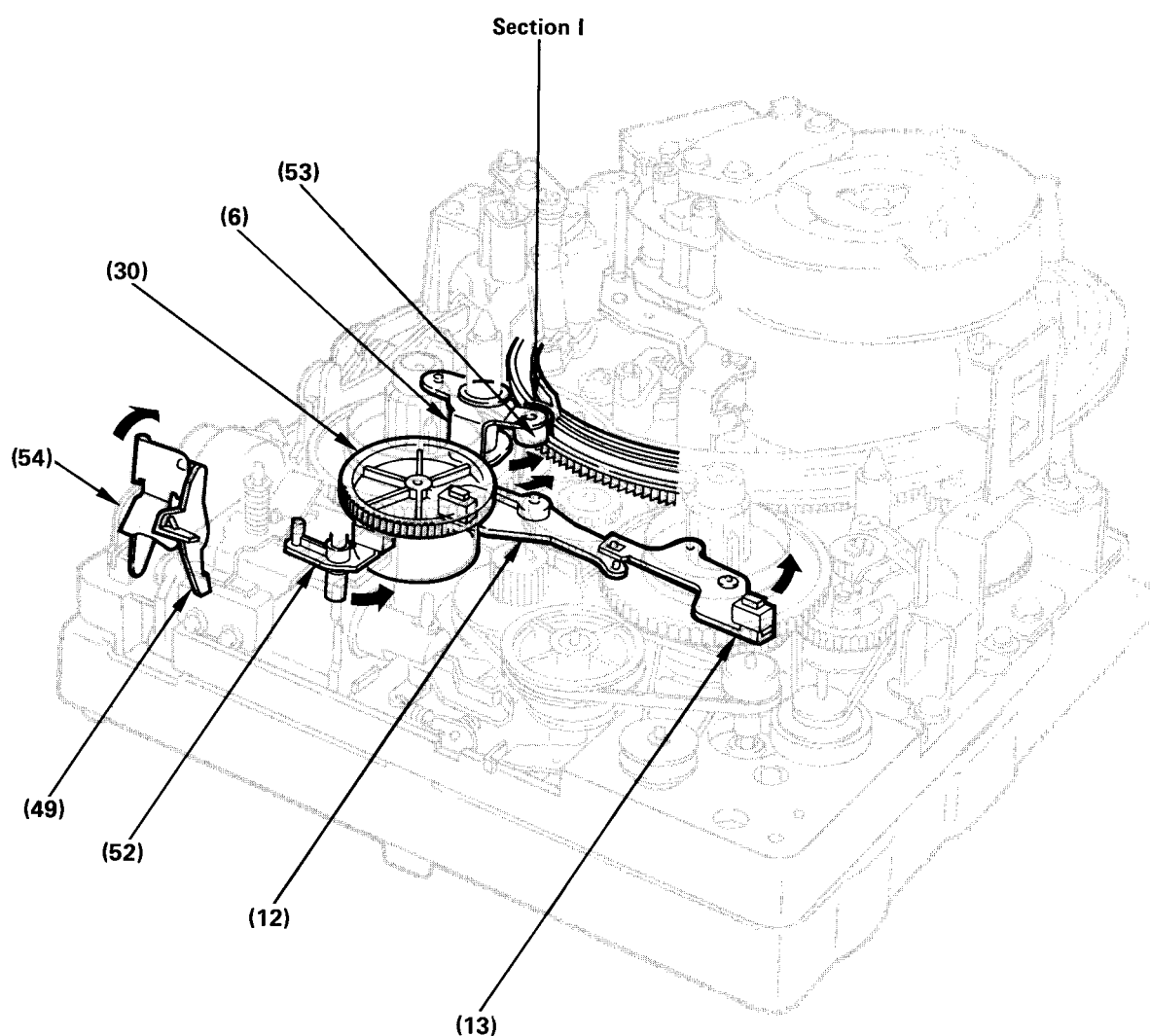


Fig. 3-3-19

PRODUCT SAFETY NOTICE

The components designated by a symbol ($\triangle$) in this schematic diagram designates components whose value are of special significance to product safety. Should any component designated by a symbol need to be replaced, use only the part designated in the Parts List. Do not deviate from the resistance, wattage and voltage ratings shown.

PARTS LIST

ACCESSORIES

Ref. No.	Parts No.	Description
	143-6-411T-18200	Owner's Manual
	149-016-48	Cassette Tape, L-250
	4-243V-33101	Antenna Output Cable
	143-6-315T-01300	Accessories Box

PACKING MATERIALS

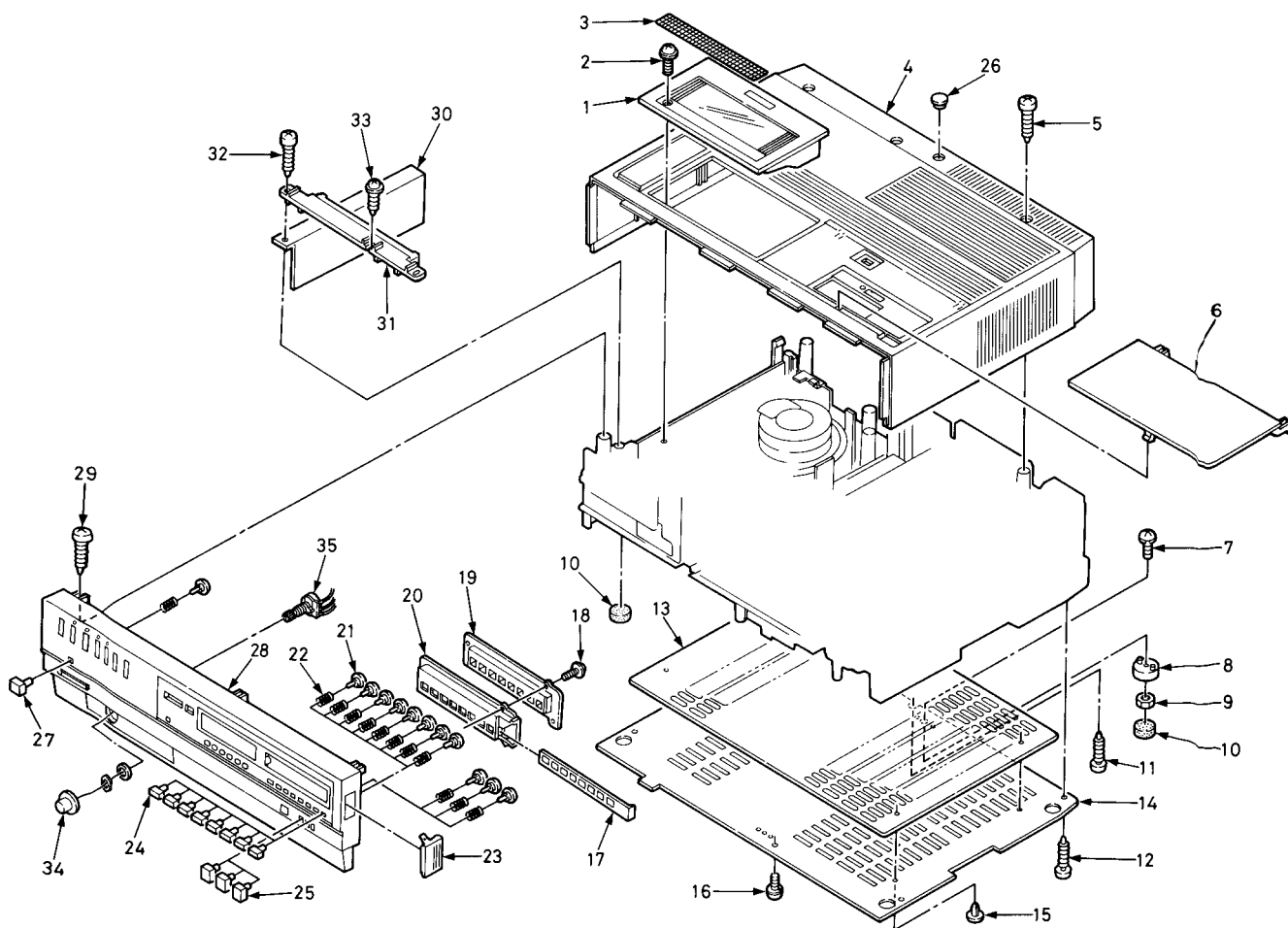
Ref. No.	Parts No.	Description
	143-6-132T-13500	Individual Carton
	143-6-251T-01700	Ind. Polyethylene Cover
	143-6-144T-04100	Right Pad
	143-6-144T-04200	Left Pad
	143-6-316T-04700	Top Sheet, Protect for Staples
	143-6-316T-04600	Bottom Sheet
	143-6-331T-01800	Protector Sheet, Cassette Cover

NOTE: Parts order must contain Model Number, and Description.

CABINET PARTS

Ref. No.	Parts No.	Description	Ref. No.	Parts No.	Description
1	143-2-135T-16100	Cover, Cassette	19	143-2-365T-09200	Holder (B), Channel Indicator Panel
2		Screw, Pan Hd., Machine, 3x6 mm, Z1	20	143-2-365T-09400	Holder (A), Channel Indicator Panel
3	143-2-241T-02000	Veil, Cassette Cover	21	143-2-464T-05700	Fixer, Operation Buttons
4	143-0-111T-01700	Cabinet	22	143-2-851T-53900	Spring Coil, Operation Buttons
5		Screw, Pan Hd., Tapping, 4x20 mm, ZK	23	143-2-133T-04100	Compartment Lid, Channel Indicator Panel
6	143-0-133T-00900	Channel Pre-set Compartment Lid	24	143-2-161T-10400	Channel Button
7		Screw, Pan Hd., Machine, 3x4 mm, Z1	25	143-2-161T-12100	Push Button (3 used), POWER ON, OFF & TIMER
8	143-2-174T-02000	Foot, Bottom Lid	26	143-2-241T-02700	Rubber Cap, RF Channel Selector
9		Hex. Nut, 3 mm, Z1	27	143-2-161T-11800	REC LOCK Button
10	143-2-174T-02400	Plastic Cushion (5 used)	28	143-0-122T-02400	Front Panel
11		Screw, Pan Hd., Tapping, 3x16 mm, ZK	29		Screw, Pan Hd., Tapping, 4x20 mm, Z1
12		Screw, Pan Hd., Tapping, 4x16 mm, ZK	30	143-2-327T-04800	Insulator, SV-1 PCB.
13	143-2-327T-04500	Bottom Insulation Sheet	31	143-2-241T-01400	Mechanism Cover
14	143-2-125T-03200	Bottom Lid	32		Screw, Pan Hd., Tapping, 4x16 mm, Z1
15	143-2-464T-06500	Fixer (4 used), Bottom Insulation Sheet	33		Screw, Pan Hd., Tapping, 3x16 mm, Z1
16		Screw, Pan Hd., Machine, 3x6 mm, ZK	34	143-2-163T-02700	Tracking Control Knob
17	143-0-236T-00400	Channel Indicator Panel with Indications	35	4-222V-14100	Tracking Control VR.
(17)	143-2-236T-01000	Channel Indicator Panel			
(17)	143-2-289T-05000	Channel Indicator, 9 pcs.			
18		Screw, Pan Hd., Tapping, 3x10 mm, Z1			

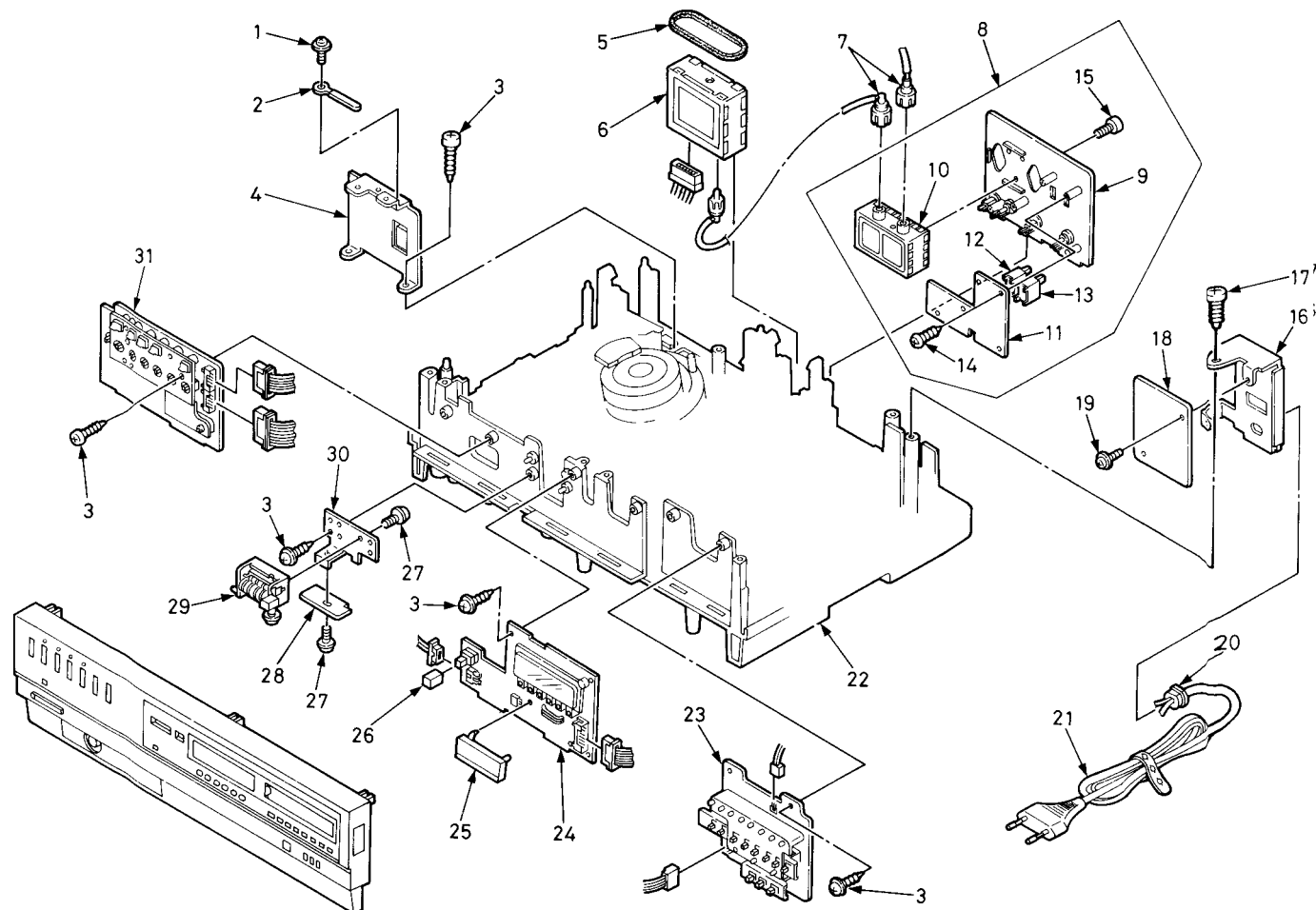
NOTE: Parts order must contain Model Number, and Description.



FRONT CONTROL & REAR TERMINAL PARTS

Ref. No.	Parts No.	Description	Ref. No.	Parts No.	Description
1		Screw, Washer Hd., Machine (TP Screw), 3x6 mm, Z1	18	143-9-0500-04200	PW-2 Circuit Board Assembly, AC. Power Supply
2	141-2-472T-01201	Lug, Wire Clamper	19		Screw, Washer Hd., Tapping, 3x6 mm, Z1
3		Screw, Pan Hd., Tapping, 3x10 mm, Z1	20	143-2-464T-02700	Fixer, Power Cord
4	143-2-351T-47200	Bracket, Mechanism Grounding	21	△ 4-243V-12710	Power Cord
5	143-2-564T-02900	Square Belt, Protect for RF Convertor	or	△ 4-243V-13900	Power Cord
6	143-9-4300-44700	RF Convertor	22	143-2-312T-06100	Main Chassis
7	4-243V-35902	RF-RF Connector Cable (2 used)	23	143-9-0600-03300	TN-3 Circuit Board Assembly, Channel Select
8	143-0-237V-00401	Antenna Terminal Board Assembly	24	143-9-0700-04200	TM-1 Circuit Board Assembly, Timer
9	4-237V-15900	Antenna Terminal Board	25	143-2-351T-47200	Protector, TM-1 PCB.
10	4-115V-15200	Antenna Booster	26	143-2-161T-10700	MEMORY ON/OFF Button
11	4-226V-85500	P.C. Board, Antenna Terminal	27		Screw with Spring & Flange Washer, Pan Hd., Machine, 3x6 mm, Z1
12	4-231V-19900	Slide Switch, TEST SIGNAL ON/OFF	28	143-9-1300-00200	MC-1 Circuit Board Assembly, Counter
13	4-231V-19800	Slide Switch, TUNER/EXT. IN	29	143-2-811T-00900	Counter
14		Screw, Pan Hd., Tapping, 3x8 mm, Z1	30	143-2-812T-02700	Bracket, Counter
15		Screw, Binding Hd., Machine, 3x6 mm, ZK	31	143-9-0300-05000	SY-2 Circuit Board Assembly, Control
16	143-2-367T-04001	Bracket, Power Cord			
17		Screw, Pan Hd., Tapping, 4x16 mm, Z1			

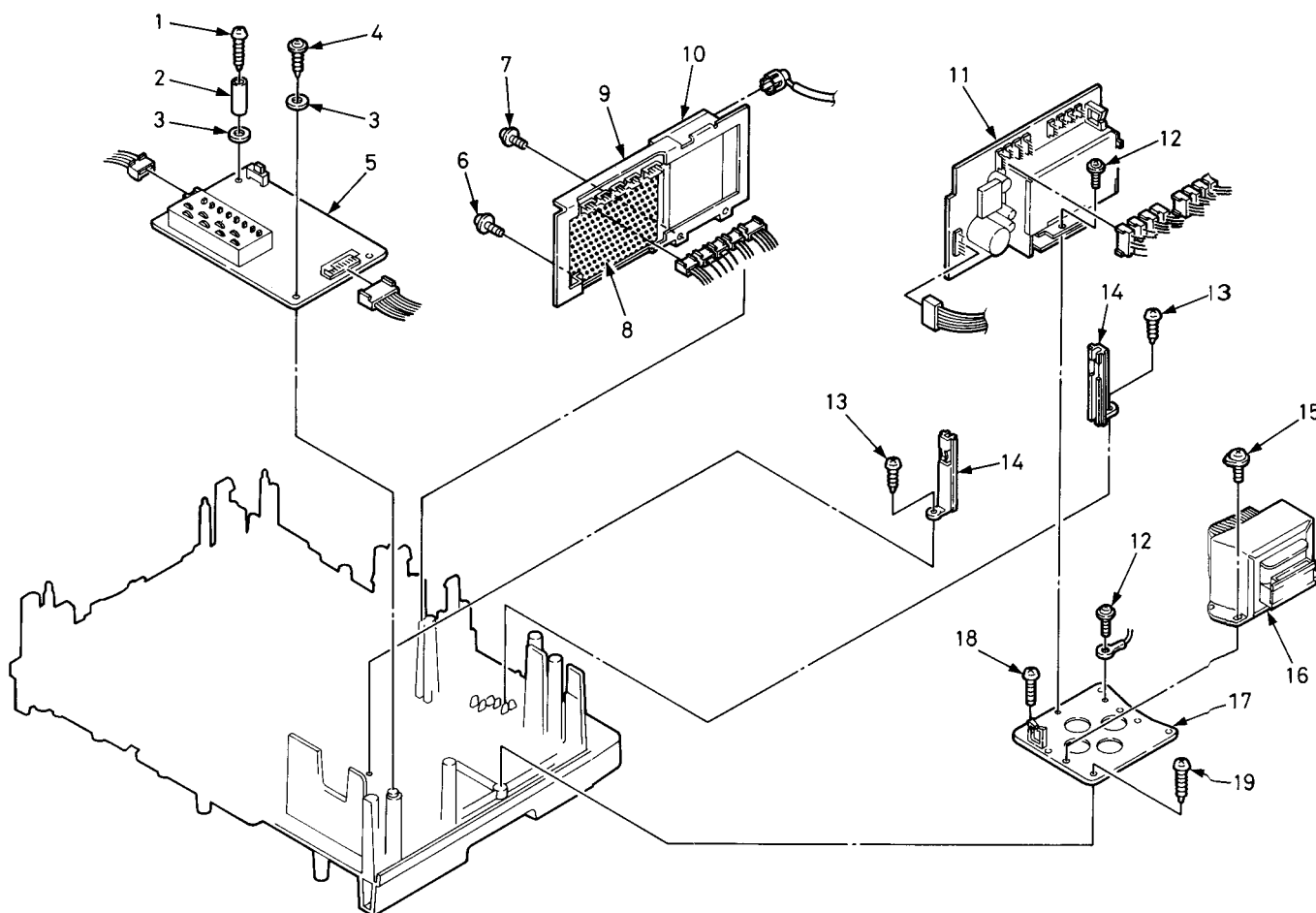
NOTE: Parts order must contain Model Number, and Description.



RIGHT SIDE PCB's PARTS

Ref. No.	Parts No.	Description	Ref. No.	Parts No.	Description
1		Screw, Pan Hd., Tapping, 3x25 mm, Z1	11	143-9-0500-04100	PW-1 Circuit Board Assembly, DC. Power Supply
2	143-2-461T-03300	Reinforcement Pipe, Cabinet	12		Screw, Washer Hd., Machine(TP Screw), 3x6 mm, Z1
3	141-2-453T-01700	Fiber Washer, 3x10x1 mm	13		Screw, Pan Hd., Tapping, 4x8 mm, Z1
4		Screw, Washer Hd., Tapping, 3x16 mm, Z1	14	143-2-377T-12200	Bracket, PCB.
5	143-9-0600-03200	TN-2 Circuit Board Assembly, Channel Pre-set	15		Screw, Washer Hd., Machine(TP Screw), 4x8 mm, Z1
6		Screw, Washer Hd., Machine(TP-S tight), 3x8 mm, Z1	16	△ 4-251V-22100	Power Transformer
7		Screw, Washer Hd., Machine(TP-S tight), 3x6 mm, Z1	or	△ 4-251V-22200	Power Transformer
8	143-9-0600-03100	TN-1 Circuit Board Assembly, IF.	17	143-2-371T-00400	Bracket, Power Transformer
9	143-2-312T-07900	Frame, Tuner & TN-1 PCB.	18		Screw, Pan Hd., Machine, 4x18 mm, Z1
10	4-115V-14400	Tuner	19		Screw, Pan Hd., Tapping, 4x16 mm, Z1

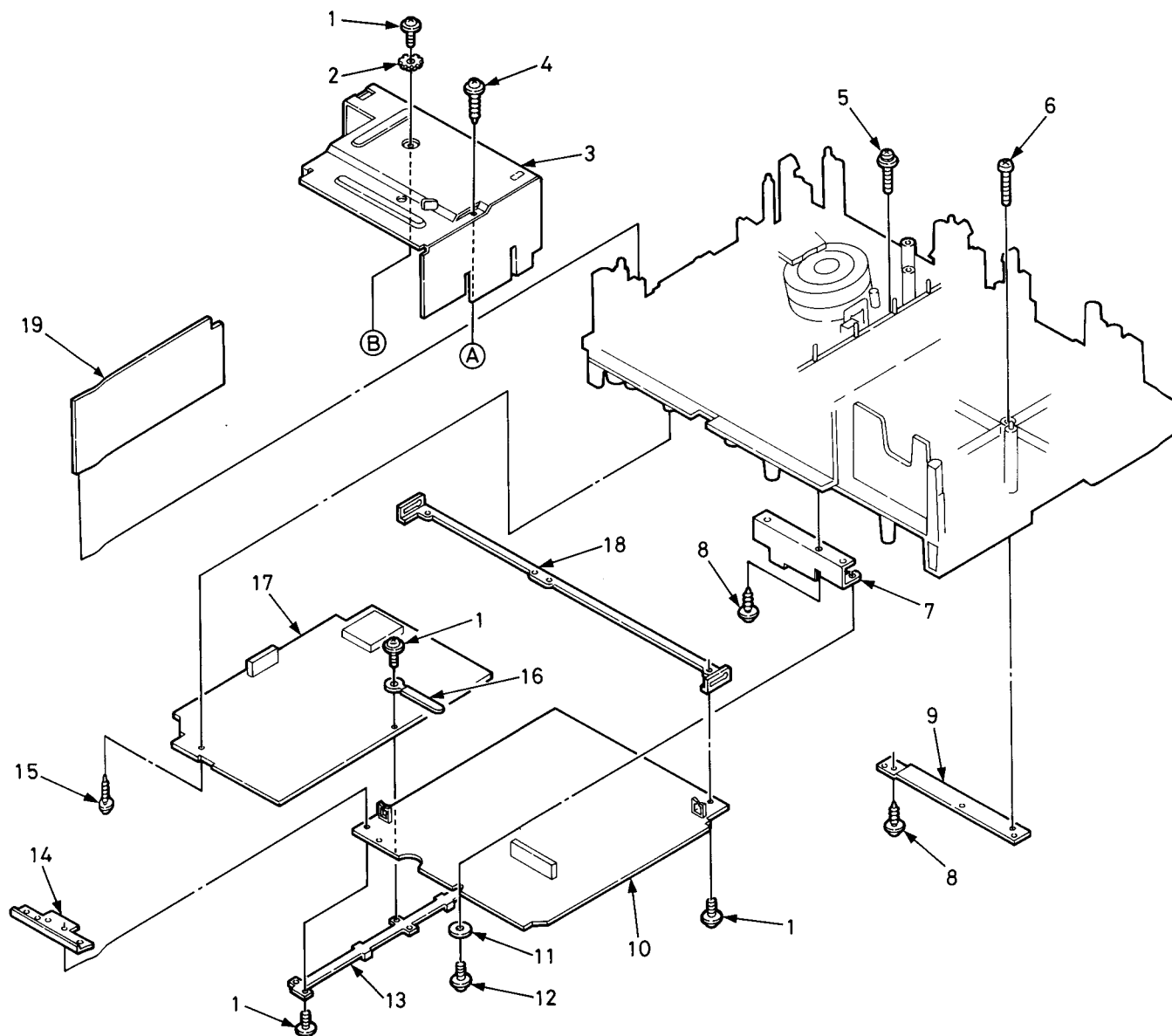
NOTE: Parts order must contain Model Number, and Description.



BOTTOM & LEFT SIDE PCB's PARTS

Ref. No.	Parts No.	Description	Ref. No.	Parts No.	Description
1	143-0-322T-01900	Screw, Washer Hd., Machine (TP Screw), 3x6 mm, Z1	11	141-2-453T-01700	Fiber Washer, 3x10x1 mm
2		Lock Washer, External Toothed, 3 mm, Z1	12		Screw, Washer Hd., Machine (TP Screw), 3x6 mm, ZR
3		Shield Plate, Top	13	143-2-377T-12400	Bracket (B), PCB's Joiner
4		Screw, Pan Hd., Tapping, 4x16 mm, Z1	14	143-2-377T-13800	PCB. Bracket, Reinforcement
5		Screw with Spring & Flange Washer, Pan Hd., Machine, 4x20 mm, Z1	15	141-2-472T-01201	Screw, Pan Hd., Tapping, 4x16 mm, ZR
6		Screw, PanHd., Machine, 4x20 mm, ZK	16		Lug, Wire Clamper
7		Bracket, PCB.	17	143-9-0100-03300	VD-1 Circuit Board Assembly, Video, Video Pre-amp. & Audio
8		Screw, Pan Hd., Tapping, 3x10 mm, Z1	18	143-2-377T-12300	Bracket (A), PCB. Shaft
9		Grounding Plate, Mechanism	19	143-9-0400-03300	SV-1 Circuit Board Assembly, Servo
10		VD-2 Circuit Board Assembly, Video & System Control			

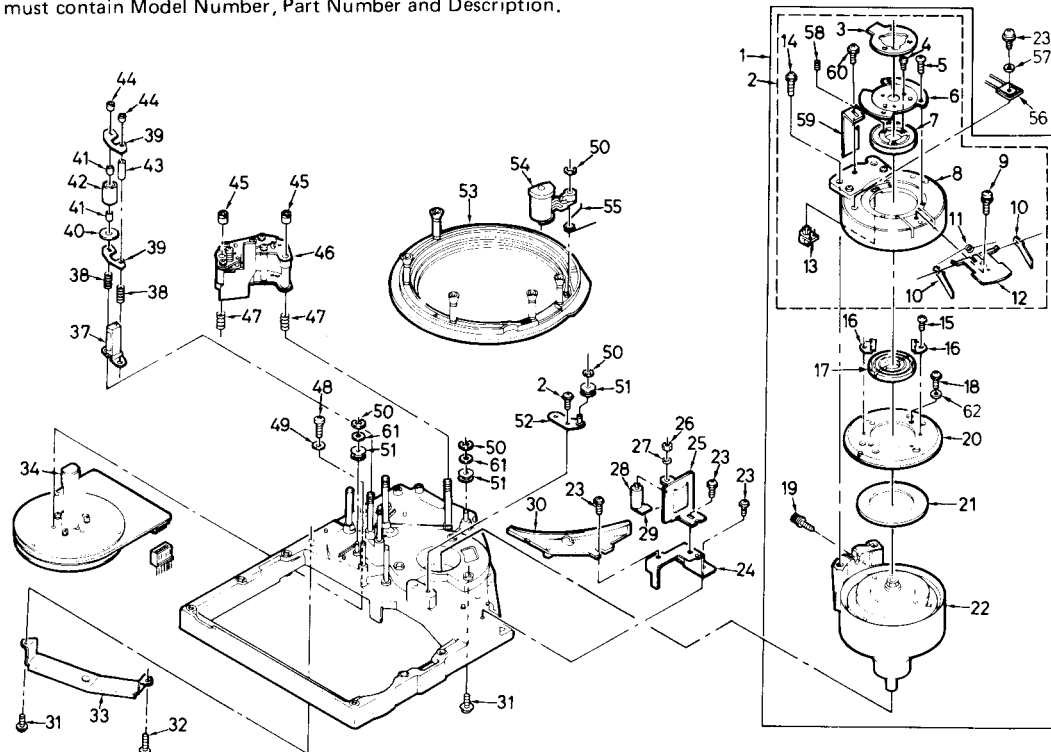
NOTE: Parts order must contain Model Number, and Description.



DRUM, CAPSTAN & PINCH ROLLER PARTS

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
1	143-9-5100-36600	Drum Complete	31		Screw with Spring & Flange Washer, Pan Hd., Machine, 3x8 mm, Z1
2	143-0-771T-02400	Upper Drum Complete	32		Screw with Spring & Flange Washer, Pan Hd., Machine, 3x16 mm, Z1
3	4-226V-75350	Wiring PCB.	33	143-2-351T-46700	Bracket, Capstan Motor
4		Screw, Pan Hd., Machine, 2.6x3 mm, Z1	34	4-527V-50700	Capstan Motor
5		Screw, Pan Hd., Machine, 2.6x6 mm, Z1	37	143-0-242V-01400	Erase Head
6	143-2-351T-43500	Bracket, Upper Rotary Trans.	38	143-2-851T-51000	Spring Coil (2 used), Erase Head
7	143-0-260V-00400	Rotary Trans., Upper	39	143-2-821T-07400	Tape Guide (2 used), Erase Head
8	143-2-776T-01250	Upper Drum	40	143-2-457T-04600	Special Washer, Erase Head
9		Screw with Spring Washer & Washer, Pan Hd., Machine, 3x6 mm, Z1	41	143-2-683T-08300	Sleeve (2 used), Erase Head Roller
10	143-2-741T-34300	Tape Path Lever (2 used)	42	143-2-662T-00800	Roller, Erase Head
11	143-2-851T-56900	Spring Coil, Tape Path Lever	43	143-2-821T-06701	Tape Guide Shaft, Erase Head
12	143-2-747T-05600	Bracket, Tape Path Lever	44	143-2-421T-03400	Special Nut (2 used), Erase Head
13	4-264V-14100	P.G. Coil	45	143-2-421T-03200	Special Nut (2 used), Audio/Control Head
14		Screw with Washer, Pan Hd., Machine, 4x12 mm, Z1	46	143-0-242V-01200	Audio/Control Head Assembly
15		Screw, Pan Hd., Machine, 2.6x4 mm, Z1	47	143-2-851T-56800	Spring Coil (2 used), Audio/Control Head
16	143-2-371T-00500	Bracket (2 used), Lower Rotary Trans. Fix	48		Screw, Pan Hd., Machine, 3x10 mm, Z1
17	4-260V-00600	Lower Rotary Trans.	49	143-2-457T-06300	Special Washer (3 used)
18		Screw, Pan Hd., Machine, 3x6 mm, Z1	50		"E" Ring, 2.3 mm
19		Screw with Spring Washer & Washer, Pan Hd., Machine, 3x8 mm, Z1	51	143-2-662T-09200	Guide Roller (3 used), Loading Ring
20	143-0-242V-01700	Video Head Disk	52	143-0-351T-07500	Bracket, Loading Ring Guide Roller
21	143-2-772T-02600	Spacer, V-head Adj., 0.02 mm Dia	53	143-0-683T-00250	Loading Ring
or	143-2-772T-02700	Spacer, V-head Adj., 0.04 mm Dia	54	143-0-545T-01700	Pinch Roller
		Not use.	55	143-2-851T-55600	Spring Coil, Pinch Roller
22	143-0-771T-02100	Lower Drum Complete	56	4-221V-11500	DEW Sensor
23		Screw with Spring & Flange Washer, Pan Hd., Machine, 3x6 mm, Z1	57		Fiber Washer, 3x8x0.5 mm
24	143-2-351T-44800	Bracket, Pinch Lever Guide	58		Set Screw, Hex. Socket Hd., Machine (Flat Point), 2.6x4 mm, CP
25	143-2-351T-44700	Bracket, REW Sensor	59	143-2-322T-20600	Shield Plate, R/P Head
26		Hex. Nut, 3 mm	60		Screw, Washer Hd., Machine (TP Screw), 3x4 mm, Z1
27		Spring Washer, 3 mm	61	141-2-453T-30300	Washer, 3x5.4x0.13 mm
28	4-258V-13500	REW Sensor	62	143-2-451T-06800	Special Washer
29	4-226V-78950	MC-3 PCB.			
30	143-2-351T-44100	Cover, Pinch Roller Lever Guide			

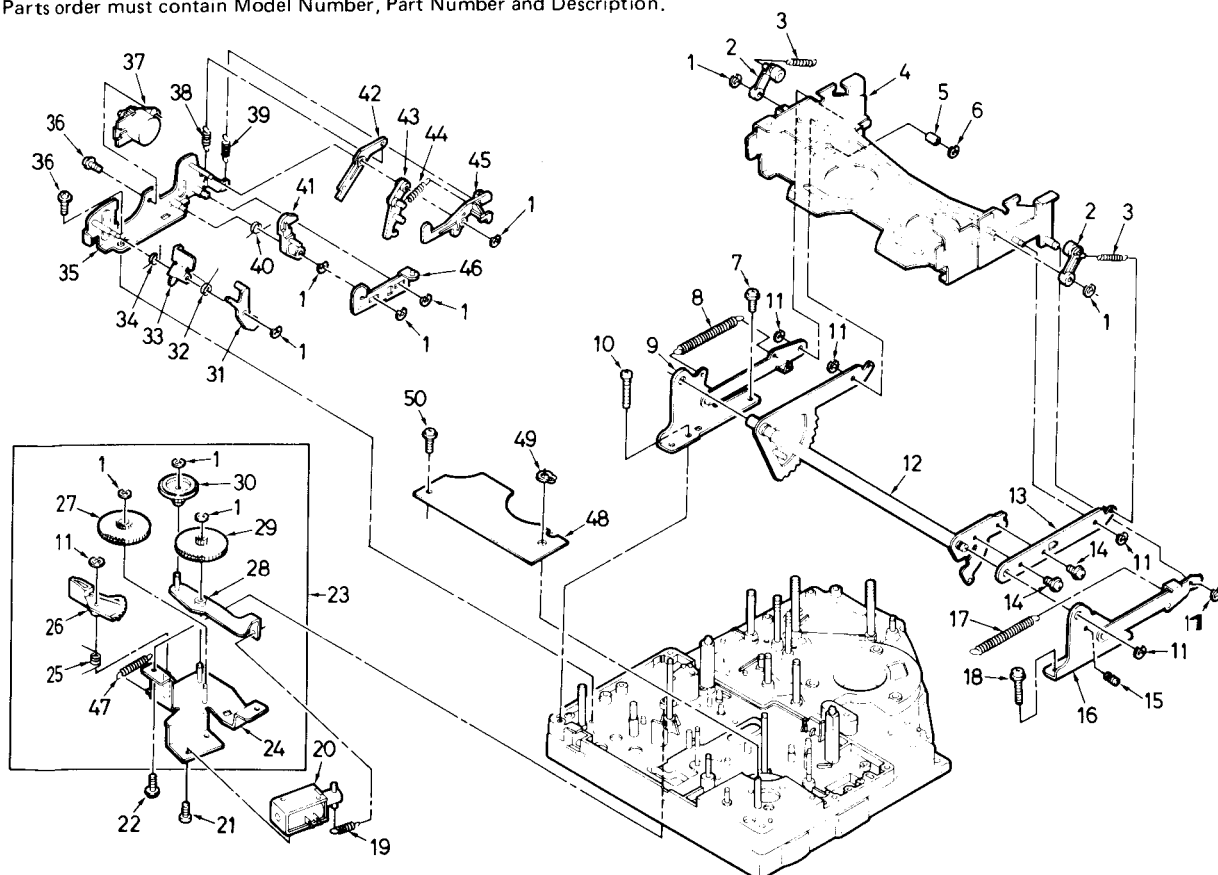
NOTE: Parts order must contain Model Number, Part Number and Description.



CASSETTE HOLDER MECHANISM PARTS

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
1		"E" Ring, 2.3 mm	26	143-2-741T-36301	Lever, "EJECT" Drive
2	143-2-741T-32900	Lever (2 used), Cassette Hold	27	143-2-581T-04600	1 st. Gear, "EJECT" Drive
3	143-2-851T-55000	Spring Coil (2 used), Cassette Hold	28	143-0-741T-18800	Lever, "EJECT" Drive Gears
4	143-0-351T-06900	Cassette Holder	29	143-2-581T-04500	2 nd. Gear, "EJECT" Drive
5	143-2-662T-08900	Roller, Cassette Holder Lock	30	143-0-581T-01700	Gear, Operation "EJECT"
6		"E" Ring, 1.5 mm	31	143-2-741T-35400	Lock Lever, "EJECT"
7		Screw, Washer Hd., Tapping (B-tight), 3x10 mm, Z1	32	143-2-851T-57400	Spring Coil, "EJECT" Lock Lever
8	143-2-851T-54900	Cassette-up Spring Coil, Left Side	33	143-2-741T-35500	Release Lever, "EJECT" Lock Lever
9	143-0-351T-07000	Cassette Holder Stand, Left Side	34	143-2-851T-57300	Spring Coil, Return for Release Lever
10		Screw, Washer Hd., Machine (TP Screw), 3x18 mm, Z1	35	143-0-351T-07900	Bracket, Cassette-up Damper
11		"E" Ring, 3 mm	36		Screw, Washer Hd., Tapping (B-tight), 3x8 mm, Z1
12	143-0-751T-01500	Shaft, Cassette-up	37	143-0-774T-00501	Oil Damper
13	143-2-741T-32700	Bracket, Cassette-up	38	143-2-851T-57000	Spring Coil, Stopper Lever
14		Screw, Washer Hd., Machine (TP Screw), 3x4 mm, Z1	39	143-2-851T-57100	Spring Coil, Cassette Actuate Lever
15	143-2-421T-04400	Adjustment Screw, Cassette-up	40	143-2-851T-56500	Spring Coil, Cassette Holder Lock Lever
16	143-0-351T-07100	Cassette Holder Stand, Right Side	41	143-2-741T-35000	Lever, Cassette Holder Lock
17	143-2-851T-54800	Cassette-up Spring Coil, Right Side	42	143-2-741T-34900	Stopper Lever, Cassette Holder Lock Lever
18		Screw with Spring Washer & Washer, Pan Hd., Machine, 3x24 mm, Z1	43	143-2-741T-34700	Operation Lever, Cassette Switch
19	143-2-851T-57600	Spring Coil, Operation "EJECT"	44	143-2-851T-57200	Spring Coil, Operation Lever
20	4-264V-12900	Solenoid, Operation "EJECT"	45	143-2-741T-34800	Lever, Cassette Actuator
21		Screw with Spring & Flange Washer, Pan Hd., Machine, 2.6x4 mm, Z1	46	143-0-731T-01300	Release Slide, Loading Ring Stopper
22		Screw, Washer Hd., Tapping (B-tight), 3x6 mm, Z1	47	143-2-851T-57700	Spring Coil, "EJECT" Drive
23	143-0-581T-01800	Gear Assembly, Operation "EJECT"	48	143-2-135T-15200	Mechanisms Cover
24	143-0-351T-07700	Gears Base, Operation "EJECT"	49		Grip Ring, 4 mm
25	143-2-851T-57800	Release Spring Coil, "EJECT" Drive Lever	50		Screw with Spring Washer & Washer, Pan Hd., Machine, 3x5 mm, Z1

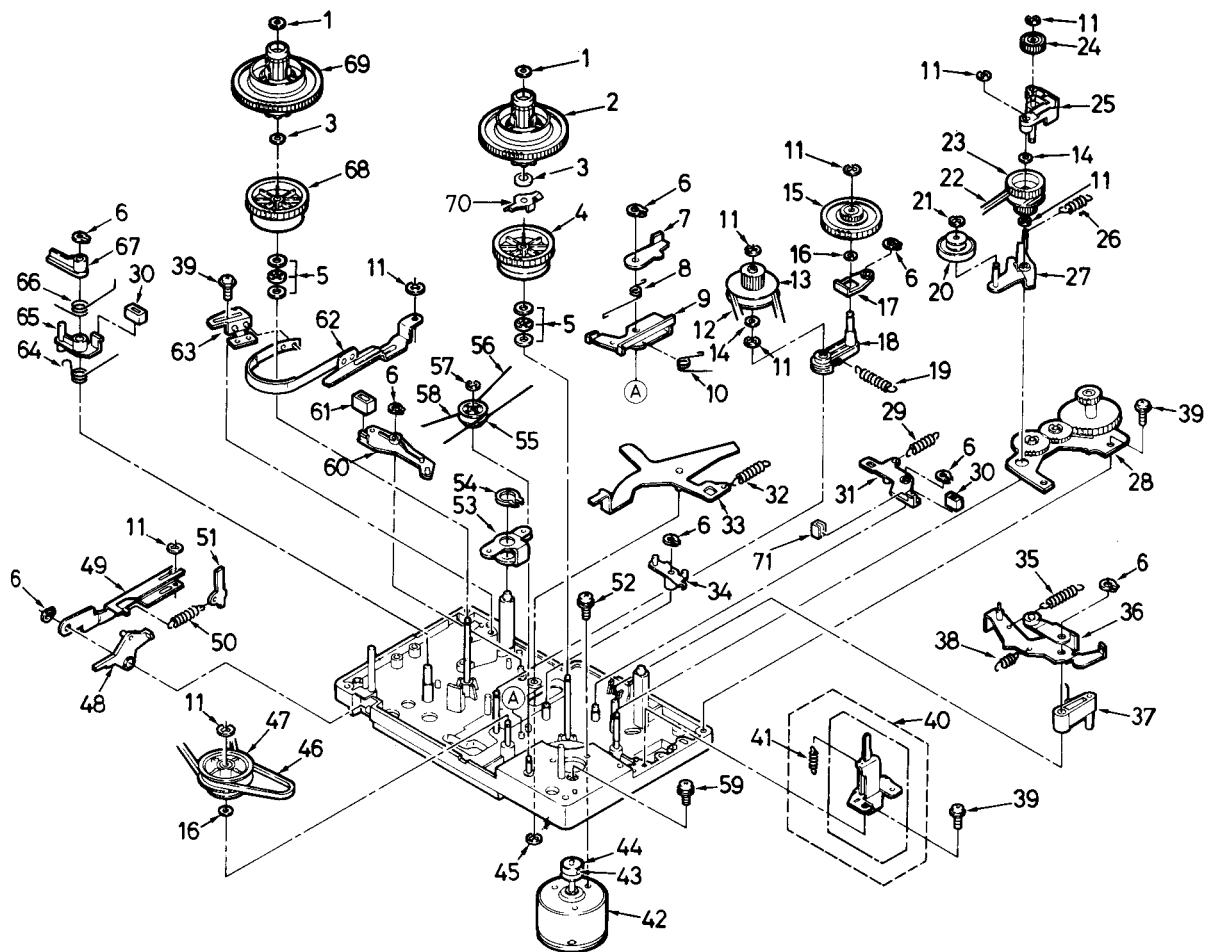
NOTE: Parts order must contain Model Number, Part Number and Description.



REEL DRIVE MECHANISM PARTS

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
1	143-2-457T-05900	Stopper (2 used), Reel Bases	56	143-2-564T-02400	Square Belt
2	143-0-531T-02700	Take-up Reel Base	57		"E" Ring, 1.5 mm
3	141-2-453T-30300	Washer, 3x5.4x0.13 mm (Reel Base Hight Adj.)	58	143-2-564T-02800	Square Belt, Counter Belt
or	141-2-453T-30301	Washer, 3x5.4x0.25 mm (Reel Base Hight Adj.)	59		Screw with Spring Washer & Washer, Pan Hd., Machine, 2.6x6 mm, Z1
or	141-2-453T-30302	Washer, 3x5.4x0.5 mm (Reel Base Hight Adj.)	60	143-2-741T-33300	Brake Lever, Supply Reel
4	143-2-581T-03700	Gear, Take-up Reel Lower	61	143-2-712T-02500	Brake Shoe, Supply Reel
5	143-2-574T-02800	Bearing (2 used), Reel Bases	62	143-0-711T-00400	Brake Band, Back Tension
6		Grip Ring, 3 mm	63	143-2-351T-43700	Bracket, Back Tension Brake Band
7	143-0-741T-19300	Back Tension Lever, R-search	64	143-2-851T-55900	Spring Coil, "EJECT" Brake Lever
8	143-2-851T-58400	Spring Coil, R-search B.T. Lever	65	143-2-741T-33500	Lever, "EJECT" Brake
9	143-2-741T-36700	Operation Lever, R-search B.T. Lever	66	143-2-851T-58000	Spring Coil, Supply Soft Brake
10	143-2-851T-58500	Spring Coil, Operation Lever	67	143-2-741T-35200	Brake Lever, Supply Soft Brake
11		"E" Ring, 2.3 mm	68	143-2-581T-03600	Gear, Supply Reel Lower
12	143-2-564T-02500	2 nd. Square Belt	69	143-0-531T-02600	Supply Reel Base
13	143-0-581T-01600	Relay Gear, Reel Drive (Center Gear)	70	143-2-853T-07200	Spring Plate
14	141-2-453T-30301	Washer, 3x5.4x0.5 mm	71	143-2-352T-09300	Spacer, Take-up Brake Shoe
15	143-0-581T-01500	Reel Drive Gear (Idler Gear)			
16	141-2-453T-30302	Washer, 3x5.4x0.5 mm			
17	143-2-253T-06100	Select Link, Reel Drive Gear			
18	143-2-741T-32500	Lever, Reel Drive Gear			
19	143-2-851T-56000	Spring Coil, Reel Drive Gear			
20	143-0-661T-03800	Loading Roller			
21		"E" Ring, 2 mm			
22	143-2-564T-02300	Square Belt, Loading Belt			
23	143-2-581T-03800	Loading Gear "1"			
24	143-2-581T-04200	Loading Gear "2"			
25	143-0-741T-19100	Lever, Loading Gear "2"			
26	143-2-851T-56400	Spring Coil, Loading Roller Pressure			
27	143-0-741T-18900	Lever, Loading Roller			
28	143-0-581T-02000	Loading Gear, Loading Ring Drive			
29	143-2-851T-56200	Spring Coil, Take-up Reel Brake Pressure			
30	143-2-712T-02300	Brake Shoe (2 used)			
31	143-2-741T-33400	Lever, Take-up Reel Brake			
32	143-2-851T-56200	Spring Coil, Brake Operation Lever			
33	143-0-741T-18100	Operation Lever, Brake			
34	143-2-741T-33200	Operation Lever, Loading Gear			
35	143-2-851T-55800	Spring Coil, Loading End Detector Lever			
36	143-0-741T-18300	Detector Lever, Loading End			
37	143-2-741T-33700	Loading End Lever			
38	143-2-851T-55700	Spring Coil, Gear Select			
39		Screw, Washer Hd., Tapping (B-tight), 3x8 mm, Z1			
40	143-0-351T-08100	Erase Prevention Detector Block			
41	143-2-851T-58200	Spring Coil, Erase Prevention			
42	4-529V-10800	Reel Motor			
43		Set Screw, Hex. Socket Hd., Machine, (Dented point), 2.6x4 mm, CP			
44	143-2-661T-68300	Reel Motor Pulley			
45		"E" Ring, 3 mm			
46	143-2-564T-02600	1 st. Square Belt			
47	143-0-661T-03700	Relay Pulley, Reel Motor			
48	143-2-741T-35800	Lever, "EJECT"			
49	143-2-253T-06200	Link, "EJECT"			
50	143-2-851T-55500	Spring Coil, Cassette Lock Release			
51	143-2-741T-34200	Release Lever, Cassette Lock			
52		Screw with Spring & Flange Washer, Pan Hd., Machine, 2.6x8 mm, Z1			
53	143-0-741T-18200	Loading Ring Stopper Lever, Unloading Detect			
54		Grip Ring, 8 mm			
55	143-2-661T-68200	Counter Pulley			

NOTE: Parts order must contain Model Number, Part Number and Description.

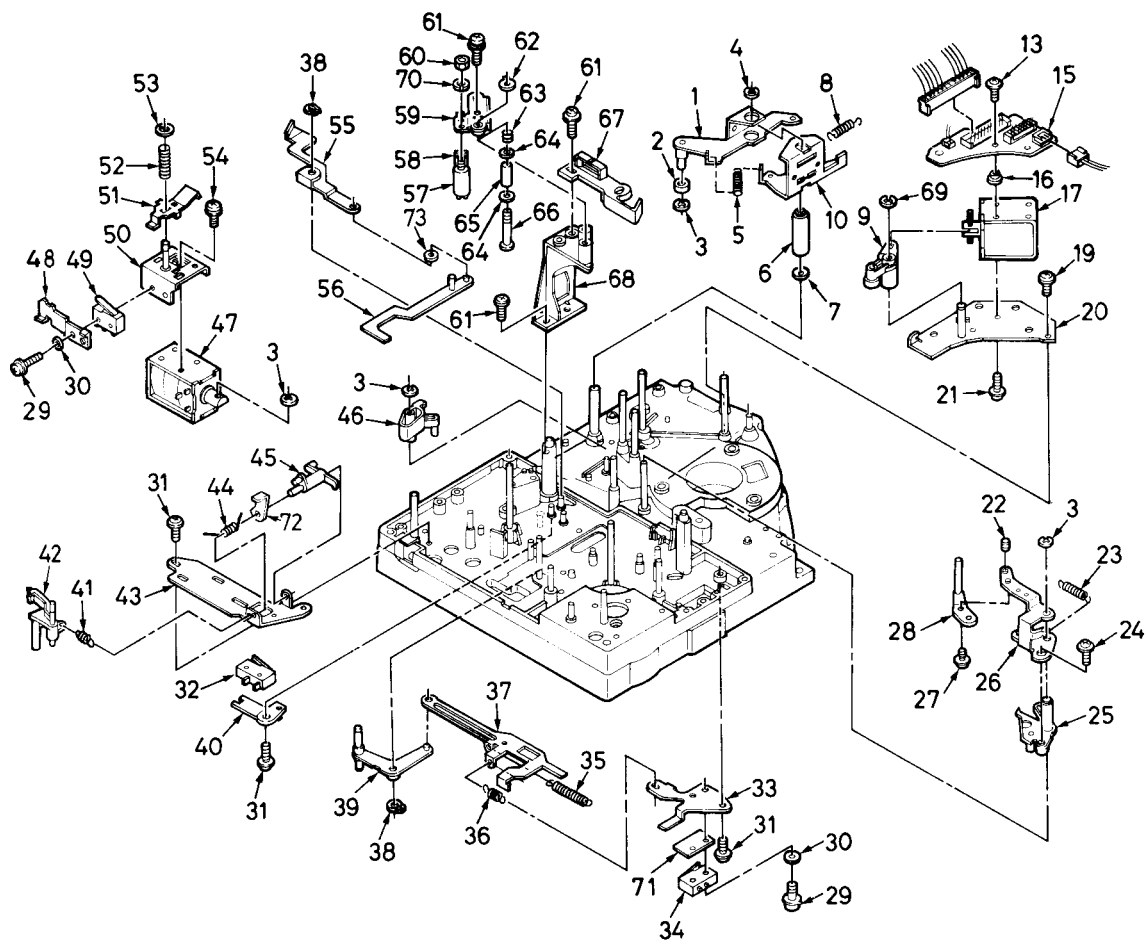


MEMO

EJECT & PINCH ROLLER PRESSURE MECHANISM PARTS

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
1	143-0-741T-18600	Lever "2", Pinch Roller Pressure	54		Screw with Spring Washer & Washer, Pan Hd., Machine, 3x4 mm, Z1
2	143-2-662T-09100	Roller, Breake Release Lever	55	143-2-741T-33800	Lever, Release Breake
3		"E" Ring, 2.3 mm	56	143-0-731T-01200	Lever, PLAY Release Breake
4		"E" Ring, 3 mm	57	4-258V-13400	FWD Sensor
5	143-2-851T-56700	Spring Coil, Pinch Roller Pressure	58	4-226V-78850	MC-2 PCB.
6	143-2-462T-03200	Pipe, Pinch Roller Pressure Lever	59	143-0-822T-01200	Bracket, FWD Sensor
7	141-2-453T-31701	Washer, 4x8x0.5 mm	60		Hex. Nut, 3 mm
8	143-2-851T-56600	Spring Coil, Pinch Roller Release	61		Screw with Spring & Flange Washer, Pan Hd., Machine, 3x8 mm, Z1
9	143-0-741T-18700	Operation Lever, Pinch Roller	62	143-2-411T-01600	Special Nut, FWD Sensor Tape Guide
10	143-2-741T-34400	Lever "1", Pinch Roller Pressure	63	143-2-851T-58100	Spring Coil, FWD Sensor Tape Guide
13		Screw, Washer Hd., Machine (TP Screw), 3x8 mm, Z1	64	143-2-457T-06100	Special Washer (2 used), FWD Sensor Tape Guide
15	143-9-1300-00700	MC-7 Circuit Board Assembly, Wiring	65	143-2-821T-08000	Tape Guide, FWD Sensor
16	143-2-683T-10400	Ring (2 used), PCB. Spacer	66	143-2-751T-50100	Shaft, FWD Sensor Tape Guide
17	4-264V-13700	Solenoid, Pinch Roller Pressure	67	143-2-135T-14600	Wiring Cover
19		Screw, Washer Hd., Machine (TP Screw), 3x10 mm, Z1	68	143-2-351T-46300	Bracket, FWD Sensor
20	143-0-351T-07600	Bracket, Pinch Roller Solenoid	69		"E" Ring, 4 mm
21		Screw, Washer Hd., Machine (TP Screw), 3x4 mm, Z1	70		Spring Washer, 3 mm
22		Set Screw, Hex. Socket Hd.(Flat point), 3x4 mm, CP	71	143-2-352T-08300	Switch Spacer
23	143-2-851T-57900	Spring Coil, Back Tension	72	143-2-465T-09700	Stopper
24		Screw, Washer Hd., Tapping (B-tight), 3x6 mm, Z1	73	141-2-453T-30302	Washer, 3x5.4x0.5 mm
25	143-2-741T-35300	Operation Lever, Back Tension			
26	143-0-741T-18500	Lever, Back Tension			
27		Screw, Washer Hd., Machine (TP Screw), 3x6 mm, Z1			
28	143-0-821T-00400	Tape Guide, Back Tension			
29		Screw with Spring Washer, Pan Hd., Machine, 2.3x12 mm, Z1			
30		Bolt Washer, 2.6x6x0.5 mm			
31		Screw, Washer Hd., Tapping (B-tight), 3x6 mm, Z1			
32	4-231V-99400	Cassette-in Switch			
or	4-231V-80301	Cassette-in Switch			
or	4-231V-99600	Cassette-in Switch			
33	143-2-351T-44300	Bracket, Switches			
34	4-231V-80400	Loading End Switch			
or	4-231V-80401	Loading End Switch			
or	4-231V-99400	Loading End Switch			
35	143-2-851T-55300	Spring Coil, EJECT Slide Release			
36	143-2-851T-55400	Spring Coil, EJECT Slide			
37	143-2-731T-08700	EJECT Slide			
38		Grip Ring, 3 mm			
39	143-0-741T-18400	Joint Lever, EJECT			
40	143-2-351T-44200	Bracket, Cassette Switch			
41	143-2-851T-56300	Spring Coil, F FWD/REW Solenoid Lever			
42	143-0-741T-18000	Lever, F FWD/REW Solenoid			
43	143-2-351T-45600	Bracket, F FWD/REW Solenoid			
44	143-2-851T-57500	Spring Coil, Gear Select Lever			
45	143-0-741T-17900	Select Lever, Reel Drive Lever			
46	143-2-741T-35100	Operation Lever, Back Tension Lever			
47	4-264V-13800	F FWD/REW Solenoid			
48	143-2-351T-47100	Wiring Bracket			
49	4-231V-80301	EJECT "2" Switch			
or	4-231V-80400	EJECT "2" Switch			
or	4-231V-99600	EJECT "2" Switch			
50	143-0-351T-08000	Bracket, EJECT "2" Switch			
51	143-2-741T-36500	Operation Lever, EJECT "2" Switch			
52	143-2-851T-58300	Spring Coil, EJECT "2" Switch			
53		Speed Nut, 2.4 mm, CP			

NOTE: Parts order must contain Model Number, Part Number and Description.



MEMO

ELECTRICAL PARTS

NOTE:

* Materials of Capacitors are abbreviated as follows;

Elect., ... Electrolytic Capacitor
 NP. Elect., ... Non-Polarized Electrolytic
 Mylar Mylar Film Capacitor
 Polypro Polypropylene Capacitor
 M. Polypro Metallized Polypropylene Capacitor
 TF Thin Film Capacitor

* Tolerance of Capacitor are noted with follow symbols;

A +50-10% M ±20%
 G ±2% N ±30%
 J ±5% P +100-0%
 K ±10% Z +80-20%

* All resistors are of carbon type, ±5%, 1/4 watt unless otherwise noted.

(1) VD-1 PCB. ELECTRICAL PARTS

Schematic Location	Parts No.	Description	Schematic Location	Parts No.	Description
		*VIDEO "1" CIRCUIT ... Location No. 1001~			(IC's & TRANSISTORS)
RY1001	4-232V-14600	Relay, MZ12S	Q1001		IC, HA11703
DL1001	4-284V-13400	Delay Line, 1H	Q1002		IC, TC4069P
DL1002	4-284V-13600	Delay Line, 270ns	Q1003		IC, HA11701
DL1003	4-284V-13600	Delay Line, 270ns	Q1004		IC, LA7013
		(VARIABLE RESISTORS)	Q1005		2SA844D or 2SA838B or C
VR1001	4-222V-61705	1K ohms	Q1006		2SC930E or D
VR1002	4-222V-61705	1K ohms	Q1007		2SC1741Q or R
VR1003	4-222V-61706	2K ohms	Q1008		2SC1741Q or R
VR1004	4-222V-61709	20K ohms	Q1009		2SC930E or D
VR1005	4-222V-61707	5K ohms	Q1010		2SC930E or D
VR1006	4-222V-61707	5K ohms	Q1011		2SC930E or D
VR1007	4-222V-61707	5K ohms	Q1012		2SC930E or D
VR1008	4-222V-61709	20K ohms	Q1013		2SA844D or 2SA838B or C
VR1009	4-222V-61709	20K ohms	Q1014		2SC930E or D
VR1010	4-222V-61705	1K ohms	Q1015		2SC930E or D
VR1011	4-222V-61704	500 ohms	Q1016		2SC945Q or R or 2SC536E or F
		(COILS)	Q1017		2SA844D or 2SA838B or C
L1001	4-253V-85825	HF Choke, 100μH	Q1018		2SC945Q or R or 2SC536E or F
L1002	4-253V-85825	HF Choke, 100μH	Q1019		2SC930E or D
L1003	4-253V-85826	HF Choke, 120μH	Q1020		2SC945Q or R or 2SC536E or F
L1004	4-253V-85828	HF Choke, 180μH	Q1021		2SC945Q or R or 2SC536E or F
L1005	4-253V-85826	HF Choke, 120μH	Q1022		2SC945Q or R or 2SC536E or F
L1006	4-253V-85823	HF Choke, 68μH	Q1023		2SC930E or D
L1007	4-253V-85823	HF Choke, 68μH	Q1024		2SA844D or 2SA838B or C
L1008	4-253V-85816	HF Choke, 18μH	Q1025		2SA844D or 2SA838B or C
L1009	4-253V-85827	HF Choke, 150μH	Q1026		2SC930E or D
L1010	4-253V-85817	HF Choke, 22μH	Q1027		2SC930E or D
L1011	4-253V-85822	HF Choke, 56μH	Q1028		2SC930E or D
L1012	4-253V-94500	HF Choke, 5.6mH	Q1033		2SC930E or D
L1013	4-253V-85821	HF Choke, 47μH	Q1034		2SA844D or 2SA838B or C
L1014	4-253V-85827	HF Choke, 150μH	Q1035		2SC930E or D
L1015	4-253V-85816	HF Choke, 18μH	Q1036		2SC930E or D
L1016	4-253V-85816	HF Choke, 18μH	Q1037		2SC930E or D
L1017	4-253V-85816	HF Choke, 18μH	Q1039		2SB544D or E
L1019	4-253V-85817	HF Choke, 22μH	Q1040		2SC945Q or R or 2SC536E or F
L1020	4-253V-85828	HF Choke, 180μH	Q1041		2SC945Q or R or 2SC536E or F
L1021	4-253V-85829	HF Choke, 220μH			(DIODES)
L1022	4-253V-85828	HF Choke, 180μH	D1001		1S1555
L1023	4-253V-85827	HF Choke, 150μH	D1002		1S1555
		(COIL TRANSFORMERS)	D1003		1S2473 or 1SS133
T1001	4-259V-21100	HF Coil Trans.	D1004		1S2473 or 1SS133
T1002	4-259V-20200	HF Coil Trans.	D1005		1S1555
T1003	4-259V-20300	HF Coil Trans.	D1006		1S1555
			D1011		1S2473 or 1SS133
			D1013		1S2473 or 1SS133

Schematic Location	Parts No.	Description	Schematic Location	Parts No.	Description
		(CAPACITORS)			
C1001		Elect., 33mfd (M), 16V	C1077		Ceramic, 6pF (J), 50V
C1002		Ceramic, 180pF (J), 50V	C1078		Ceramic, 16pF (J), 50V
C1003		Ceramic, 100pF (J), 50V	C1079		Ceramic, 16pF (J), 50V
C1004		Ceramic, 82pF (J), 50V	C1080		Ceramic, 6pF (J), 50V
C1005		Elect., 10mfd (M), 16V	C1081		Elect., 100mfd (M), 10V
C1006		BL Ceramic, 0.01mfd (K), 25V	C1082		Elect., 100mfd (M), 10V
C1009		Elect., 10mfd (M), 16V	C1083		Elect., 47mfd (M), 16V
C1110		Elect., 1000mfd (M), 10V	C1084		BL Ceramic 0.01mfd (K), 25V
C1011		Ceramic, 13pF (J), 50V	C1085		BL Ceramic 0.047mfd (K), 25V
C1012		Ceramic, 51pF (J), 50V	C1086		Elect., 47mfd (M), 16V
C1013		Ceramic, 51pF (J), 50V	C1087		Ceramic, 51pF (J), 50V, CH
C1014		Ceramic, 13pF (J), 50V	C1088		Ceramic 27pF (J), 50V
C1015		BL Ceramic, 0.01mfd (K), 25V	C1089		BL Ceramic, 0.047mfd (K), 25V
C1016		Ceramic, 18pF (J), 50V	C1090		Ceramic, 2700pF (J), 50V
C1017		Ceramic, 47pF (J), 50V, CH	C1091		Elect., 10mfd (M), 16V
C1018		Ceramic, 18pF (J), 50V	C1092		Ceramic, 820pF (J), 50V
C1019		BL Ceramic, 0.047mfd (K), 25V	C1093		Elect., 100mfd (M), 10V
C1020		Elect., 47mfd (M), 16V	C1094		Ceramic, 120pF (J), 50V
C1021		BL Ceramic, 0.01mfd (K), 25V	C1095		Ceramic, 100pF (J), 50V
C1022		Ceramic, 680pF (J), 50V	C1096		Elect., 22mfd (M), 16V
C1023		Ceramic, 220pF (J), 50V	C1097		Ceramic, 330pF (J), 50V
C1024		Ceramic, 16pF (J), 50V	C1100		Ceramic, 0.047mfd (K), 25V
C1026		BL Ceramic 0.01mfd (K), 25V	C1101		Ceramic, 0.047mfd (K), 25V
C1027		Elect., 47mfd (M), 16V	C1102		Ceramic, 0.047mfd (K), 25V
C1028		Elect., 100mfd (M), 10V	C1104		Ceramic, 0.047mfd (K), 25V
C1029		Ceramic, 47pF (J), 50V			(RESISTORS)
C1030		Elect., 47mfd (M), 16V	R1001		1K ohms
C1031		BL Ceramic, 0.047mfd (K), 25V	R1002		1K ohms
C1032		Ceramic, 18pF (J), 50V	R1003		2.4K ohms
C1033		Ceramic, 390pF (J), 50V	R1005		3.3K ohms
C1034		Ceramic, 180pF (J), 50V	R1007		2.2K ohms
C1035		Ceramic, 300pF (J), 50V	R1008		33K ohms
C1036		Ceramic, 510pF (J), 50V	R1009		390K ohms
C1037		Ceramic, 510pF (J), 50V	R1010		750 ohms
C1038		Mylar, 0.0056mfd (J), 50V	R1011		68 ohms
C1039		Ceramic, 3300pF (J), 50V	R1012		150 ohms
C1040		BL Ceramic, 0.022mfd (K), 25V	R1013		150 ohms
C1041		Elect., 47mfd (M), 16V	R1014		3.9K ohms
C1042		BL Ceramic, 0.047mfd (K), 25V	R1015		1K ohms
C1043		Aluminium, 0.68mfd (K), 50V	R1016		1.8K ohms
C1044		Ceramic, 150pF (J), 50V	R1017		10K ohms
C1044		Ceramic, 15pF (J), 50V	R1018		1.8K ohms
C1046		Ceramic, 75pF (J), 50V	R1019		10K ohms
C1047		Elect., 47mfd (M), 10V	R1020		56K ohms
C1048		Mylar, 0.1mfd (M), 50V	R1021		1K ohms
C1049		Ceramic, 75pF (J), 50V	R1022		470 ohms
C1050		Ceramic, 33pF (J), 50V	R1023		1K ohms
C1051		Elect., 47mfd (M), 16V	R1024		100 ohms
C1052		Elect., 33mfd (M), 16V	R1025		2.2K ohms
C1053		Elect., 1mfd (M), 50V	R1026		22K ohms
C1054		Ceramic, 56pF (J), 50V	R1027		22K ohms
C1055		Ceramic, 82pF (J), 50V	R1028		3.3K ohms
C1056		Elect., 47mfd (M), 16V	R1029		1K ohms
C1057		BL Ceramic, 0.047mfd (K), 25V	R1030		1K ohms
C1058		Ceramic, 430pF (J), 50V	R1031		4.7K ohms
C1059		Ceramic, 390pF (J), 50V	R1032		1K ohms
C1060		BL Ceramic, 0.01mfd (K), 25V	R1033		750 ohms
C1063		BL Ceramic, 0.01mfd (K), 25V	R1034		330K ohms
C1064		BL Ceramic, 0.01mfd (K), 25V	R1035		560 ohms
C1065		BL Ceramic, 0.01mfd (K), 25V	R1036		1K ohms
C1067		Ceramic, 120pF (J), 50V	R1037		240 ohms
C1074		Ceramic, 120pF (J), 50V	R1038		22K ohms
C1075		Elect., 220mfd (M), 6.3V	R1039		1.5K ohms
C1076		Ceramic, 180pF (J), 50V	R1040		820 ohms

[illegible]

Schematic Location	Parts No.	Description	Schematic Location	Parts No.	Description
L1504	4-253V-85826	HF Choke, 120 μ H	C1536		Elect., 0.47mfd (M), 25V
L1505	4-253V-88317	HF Choke, 2.2mH	C1537		Ceramic, 36pF (J), 50V
L1506	4-253V-85245	HF Choke, 1mH	C1538		Ceramic, 18pF (J), 50V
L1508	4-253V-88323	HF Choke, 6.8mH	C1539		Elect., 33mfd (M), 16V
L1509	4-253V-88323	HF Choke, 6.8mH	C1540		Elect., 33 mfd (M), 16V
L1510	4-253V-85815	HF Choke, 15 μ H	C1541		Ceramic, 33pF (J), 50V
L1511	4-253V-85815	HF Choke, 15 μ H			(RESISTORS)
L1512	4-253V-85813	HF Choke, 10 μ H	R1501		3.3K ohms
		(IC's & TRANSISTORS)	R1502		390 ohms
Q1501		IC, CX-134A	R1503		10K ohms
Q1502		FET, 2SK152-2 or 3	R1504		620 ohms
Q1503		FET, 2SK152-2 or 3	R1505		390 ohms
Q1504		2SC536E or F	R1506		10K ohms
Q1505		2SC536E or F	R1507		3.3K ohms
Q1506		2SC536E or F	R1508		390 ohms
Q1507		2SC930E or F	R1509		620 ohms
Q1508		2SA838B or C or 2SA844D	R1510		390 ohms
Q1509		2SA564Q or 2SA838B or C	R1511		10K ohms
Q1510		2SC1815Y	R1512		5.6K ohms
Q1511		2SC930E or F	R1513		100 ohms
Q1512		2SC536E or F	R1514		620 ohms
Q1513		2SC930E or F	R1515		1K ohms
		(DIODES)	R1516		5.6K ohms
D1501		1S1555 or 1S2473	R1517		4.7K ohms
D1502		1S1555 or 1S2473	R1518		2.2K ohms
D1503		1S1555 or 1S2473	R1519		390 ohms
D1504		1S1555 or 1S2473	R1520		33K ohms
D1507		1S1555 or 1S2473	R1521		Non Flammable, 8.2 ohms
D1509		1S1555 or 1S2473	R1522		15K ohms
D1510		1S1555 or 1S2473	R1524		1.2K ohms
		(CAPACITORS)	R1525		560 ohms
C1501		BL Ceramic, 0.022mfd (M), 25V	R1526		1K ohms
C1502		BL Ceramic, 0.022mfd (M), 25V	R1527		1K ohms
C1503		BL Ceramic, 0.047mfd (M), 25V	R1528		1K ohms
C1504		BL Ceramic, 0.01mfd (K), 25V	R1529		1K ohms
C1505		BL Ceramic, 0.022mfd (M), 25V	R1530		2.2K ohms
C1506		BL Ceramic, 0.022mfd (M), 25V	R1531		2.2K ohms
C1507		BL Ceramic, 0.022mfd (M), 25V	R1532		10K ohms
C1508		BL Ceramic, 0.047mfd (M), 25V	R1534		Non Flammable, 8.2 ohms
C1509		BL Ceramic, 0.01mfd (K), 25V	R1535		220 ohms
C1510		Tantalum, 10mfd (M), 16V	R1538		6.8 ohms
C1511		BL Ceramic, 0.022mfd (M), 25V	R1539		430 ohms
C1512		BL Ceramic, 0.022mfd (M), 25V	R1542		Non Flammable, 8.2 ohms
C1513		Ceramic, 330pF (J), 50V	R1543		16K ohms
C1514		Elect., 10mfd (M), 16V	R1544		3.3K ohms
C1515		BL Ceramic, 0.01mfd (K), 25V	R1545		56K ohms
C1516		Ceramic, 470pF (J), 50V	R1546		10K ohms
C1517		Ceramic, 470pF (J), 50V	R1547		1K ohms
C1518		Ceramic, 51pF (J), 50V	R1548		680 ohms
C1519		BL Ceramic, 2700pF (K), 25V	R1549		390 ohms
C1520		BL Ceramic, 4700pF (K), 25V	R1550		82K ohms
C1524		Ceramic, 51pF (J), 50V	R1551		10K ohms
C1525		Ceramic, 68pF (J), 50V	R1552		430 ohms
C1526		BL Ceramic, 4700pF (K), 50V	R1553		7.5 ohms
C1527		BL Ceramic, 4700pF (K), 50V	R1554		1.5K ohms
C1528		Elect., 10mfd (M), 16V	R1555		1.5K ohms
C1529		Elect., 10mfd (M), 16V	R1556		Non Flammable, 82 ohms
C1531		BL Ceramic, 0.01mfd (K), 25V	R1557		Non Flammable, 39 ohms
C1532		Ceramic, 100pF (J), 50V	R1558		100 ohms
C1533		BL Ceramic, 0.01mfd (K), 25V	R1559		100 ohms
C1534		BL Ceramic 0.022mfd (M), 25V	R1560		470 ohms
C1535		Elect., 47mfd (M), 16V	R1561		120 ohms
			R1563		5.6K ohms
			R1564		5.6K ohms

Schematic Location	Parts No.	Description	Schematic Location	Parts No.	Description
T2001	4-258V-14100	*AUDIO CIRCUIT ... Location No. 2001 ~ Coil Transformer	C2035 C2036		Mylar, 0.01mfd (K), 50V Elect., 47mfd (M), 16V
VR2001	4-222V-64407	(VARIABLE RESISTORS) 20K ohms	R2001		(RESISTORS) 47K ohms
VR2002	4-222V-64406	10K ohms	R2002		390 ohms
VR2003	4-222V-61713	500K ohms	R2003		2.2K ohms
VR2004	4-222V-64406	10K ohms	R2004		18K ohms
L2001	4-253V-95600	(COILS) HF Choke, 27mH	R2005		33K ohms
L2002	4-253V-90101	HF Choke, 7mH	R2006		2.2K ohms
L2003	4-253V-95800	HF Choke, 27mH	R2007		47K ohms
L2004	4-253V-84110	HF Choke, 560μH	R2008		1K ohms
Q2001		(IC's & TRANSISTORS) IC, BA5102	R2009		6.8K ohms
Q2002		2SD1011S or T	R2011		8.2K ohms
Q2003		2SD1011S or T	R2012		3.3K ohms
Q2004		2SC945P or Q	R2015		3.3K ohms
Q2005		2SA1016F or G	R2016		2.2K ohms
Q2008		2SC536E or F	R2017		2.2K ohms
Q2009		2SC536E or F	R2018		120K ohms
Q2011		2SC536E or F	R2019		180 ohms
Q2012		2SD438E or F	R2023		2.2K ohms
D2001		(DIODES) 1SS133	R2024		390 ohms
D2002		1SS133	R2025		4.7K ohms
D2003		1SS133	R2026		15K ohms
D2004		1SS133	R2027		2.2K ohms
C2001		(CAPACITORS) Elect., 2.2mfd (M), 16V	R2028		10K ohms
C2002		Elect., 47mfd (M), 6.3V	R2029		10K ohms
C2003		Elect., 22mfd (M), 6.3V	R2030		10K ohms
C2004		Elect., 100mfd (M), 16V	R2031		10K ohms
C2005		Elect., 22mfd (M), 16V	R2032		10K ohms
C2006		Elect., 4.7mfd (M), 16V	R2033		3.3K ohms
C2007		Elect., 4.7mfd (M), 16V	R2034		10K ohms
C2008		Elect., 0.47mfd (M), 16V	R2035		22K ohms
C2009		BL Ceramic, 0.033mfd (K), 25V	R2036		10K ohms
C2012		Mylar, 0.15mfd (K), 50V	R2037		10K ohms
C2013		Elect., 4.7mfd (M), 16V	R2038		Non Flammable, 10 ohms
C2015		Ceramic, 200pF (K), 50V	R2044	4-221V-11400	5.6K ohms
C2016		Elect., 2.2mfd (M), 16V	R2047		2.2K ohms
C2017		Elect., 10mfd (M), 16V	R2048		5.6K ohms
C2018		Ceramic, 0.012mfd (K), 50V	R2049		10K ohms
C2019		Ceramic, 330pF (K), 50V	R2051		100K ohms
C2021		Elect., 3.3mfd (M), 16V	R2052		100K ohms
C2022		Elect., 0.47mfd (M), 16V	R2053		4.7K ohms
C2023		Elect., 100mfd (M), 16V	R2054		5.6K ohms
C2024		Ceramic, 4700pF (K), 50V			
C2025		Ceramic, 220pF (K), 50V			
C2026		Elect., 47mfd (M), 6.3V			
C2027		Ceramic, 1200pF (K), 50V			
C2028		Ceramic, 0.01mfd (M), 25V			
C2029		Ceramic, 220pF (K), 50V			
C2031		Polypropylene, 0.022mfd (K), 200V			
C2032		Aluminium, 4.7mfd (M), 25V			
C2033		Mylar, 0.033mfd (K), 50V			
C2034		Mylar, 0.01mfd (K), 50V			

(2) VD-2 PCB. ELECTRICAL PARTS

Schematic Location	Parts No.	Description	Schematic Location	Parts No.	Description
		*VIDEO "2" CIRCUIT			
		... Location No.1201 ~			
BPF1201	4-228V-15000	LC Pack	Q1215		2SC536E or F or 2SC945Q or R
PL1201	4-284V-13300	2H Delay Line	Q1216		2SC930E or D
X1201	4-225V-18400	Crystal	Q1217		2SC930E or D
or	4-225V-19000	Crystal	Q1218		2SC930E or D
X1202	4-225V-18800	Crystal	Q1219		2SC536E or F or 2SC945Q or R
or	4-225V-18900	Crystal	Q1220		2SC536E or F or 2SC945Q or R
		(VARIABLE RESISTORS)	Q1221		2SC536E or F or 2SC945Q or R
VR1201	4-222V-61704	500 ohms	Q1222		2SC930E or D
VR1203	4-222V-61705	1K ohms	Q1223		2SC536E or F or 2SC945Q or R
VR1204	4-222V-61709	20K ohms	Q1224		2SC930E or D
VR1205	4-222V-61708	10K ohms	Q1225		2SC930E or D
VR1206	4-222V-61707	5K ohms	Q1226		2SC536E or F or 2SC945Q or R
VR1207	4-222V-61713	500K ohms	Q1227		2SA608E or F or 2SA844D
VR1208	4-222V-61705	1K ohms	Q1228		2SA608E or F or 2SA844D
VR1209	4-222V-61705	1K ohms	Q1229		2SA608E or F or 2SA844D
		(COILS)	Q1230		2SA608E or F or 2SA844D
L1201	4-253V-85821	HF Choke, 47 μ H	Q1232		2SD400D or E
L1203	4-253V-85814	HF Choke, 12 μ H	Q1233		2SC536E or F or 2SC945Q or R
L1204	4-253V-85823	HF Choke, 68 μ H	Q1234		2SC930E or D
L1205	4-253V-85823	HF Choke, 68 μ H	Q1235		2SC536E or F or 2SC945Q or R
L1206	4-253V-85826	HF Choke, 120 μ H	Q1236		2SC536E or F or 2SC945Q or R
L1207	4-253V-85826	HF Choke, 120 μ H	Q1237		2SC930E or D
L1208	4-253V-85824	HF Choke, 82 μ H	Q1238		2SA564AR or AQ
L1209	4-253V-85812	HF Choke, 8.2 μ H	Q1239		2SC536E or F or 2SC945Q or R
L1210	4-253V-85817	HF Choke, 22 μ H	Q1240		2SC536E or F or 2SC945Q or R
L1211	4-253V-85823	HF Choke, 68 μ H	Q1241		2SC536E or F or 2SC945Q or R
L1212	4-253V-85833	HF Choke, 470 μ H			(DIODES)
L1214	4-253V-94200	HF Choke, 6.8mH	D1201		1S2473 or 1SS133
L1215	4-253V-85833	HF Choke, 470 μ H	D1202		1S2473 or 1SS133
L1216	4-253V-85821	HF Choke, 47 μ H	D1203		1S2473 or 1SS133
L1217	4-253V-85825	HF Choke, 100 μ H	D1204		1S2473 or 1SS133
L1218	4-253V-93300	HF Choke, 1mH	D1205		1S2473 or 1SS133
		(COIL TRANSFORMER)	D1206		1S2473 or 1SS133
T1201	4-259V-20400	HF Coil Trans.	D1207		1S2473 or 1SS133
T1202	4-259V-20500	HF Coil Trans.	D1208		1S2473 or 1SS133
T1203	4-259V-20600	HF Coil Trans.	D1209		1S2473 or 1SS133
T1204	4-259V-20700	HF Coil Trans.	D1210		1S2473 or 1SS133
T1205	4-259V-15700	HF Coil Trans.	D1211		1S2473 or 1SS133
T1206	4-259V-15800	HF Coil Trans.	D1212		1S2473 or 1SS133
T1207	4-259V-20800	HF Coil Trans.	D1213		1S2473 or 1SS133
T1208	4-259V-20900	HF Coil Trans.	D1214		1S2473 or 1SS133
T1209	4-259V-21000	HF Coil Trans.	D1215		1S2473 or 1SS133
T1210	4-253V-92800	HF Choke Coil, 4.7mH	D1216		1S2473 or 1SS133
or	4-253V-94900	HF Choke Coil, 4.7mH	D1217		1S2473 or 1SS133
		(IC's & TRANSISTORS)	D1218		Zener, RD6.2EB or GZ A6.2Y
Q1201		IC, CX832	D1219		Zener, RD5.6EB1 or GZ A5.6Y
Q1202		IC, TC4053BP	D1220		1S2473 or 1SS133
Q1203		IC, CX136A			
Q1204		IC, CX150A			
Q1205		IC, MB14300A			
Q1206		IC, M58478P			
Q1207		2SC930E or D			
Q1208		2SC930E or D			
Q1209		2SC930E or D			
Q1210		2SC930E or D			
Q1211		2SC930E or D			
Q1212		2SC930E or D			
Q1213		2SC930E or D			
Q1214		2SC930E or D			

Schematic Location	Parts No.	Description	Schematic Location	Parts No.	Description
		(CAPACITORS)			
C1201		BL Ceramic, 0.01mfd (K), 25V	C1271		Elect., 1mfd (M), 50V
C1202		BL Ceramic, 0.01mfd (K), 25V	C1272		Ceramic, 1000pF (J), 50V
C1203		Ceramic, 5pF (J), 50V	C1273		Ceramic, 4700pF (J), 50V
C1205		BL Ceramic, 0.047mfd (K), 25V	C1274		Ceramic, 330pF (J), 50V
C1206		BL Ceramic, 0.01mfd (K), 25V	C1275		Mylar, 0.01mfd (M), 50V
C1207		BL Ceramic, 0.01mfd (K), 25V	C1278		Ceramic, 30pF (J), 50V
C1208		BL Ceramic, 0.047mfd (K), 25V	C1279		Ceramic, 1000pF (J), 50V
C1209		Elect., 47mfd (M), 16V	C1280		Ceramic, 1000pF (J), 50V
C1210		BL Ceramic, 0.01mfd (K), 25V	C1281		BL Ceramic, 0.01mfd (K), 25V
C1212		BL Ceramic, 0.01mfd (K), 25V	C1282		BL Ceramic, 0.01mfd (K), 25V
C1213		BL Ceramic, 0.022mfd (K), 25V	C1283		BL Ceramic, 0.01mfd (K), 25V
C1214		Tantalum, 2.2mfd (J), 16V	C1284		BL Ceramic, 0.01mfd (K), 25V
C1215		BL Ceramic, 0.01mfd (K), 25V	C1285		Elect., 1mfd (M), 50V
C1216		Elect., 47mfd (M), 16V	C1286		Ceramic, 2200pF (J), 50V
C1217		Elect., 1mfd (M), 50V	C1287		Ceramic, 120pF (J), 50V
C1218		Elect., 47mfd (M), 10V	C1288		BL Ceramic, 0.01mfd (K), 25V
C1219		Ceramic, 100pF (J), 50V	C1289		BL Ceramic, 0.01mfd (K), 25V
C1220		BL Ceramic, 0.047mfd (K), 25V	C1290		BL Ceramic, 0.01mfd (K), 25V
C1221		Ceramic, 330pF (J), 50V	C1291		BL Ceramic, 0.01mfd (K), 25V
C1222		Ceramic, 100pF (J), 50V	C1292		BL Ceramic, 0.01mfd (K), 25V
C1223		BL Ceramic, 0.01mfd (K), 25V	C1293		BL Ceramic, 0.01mfd (K), 25V
C1224		BL Ceramic, 0.047mfd (K), 25V	C1294		Ceramic, 150pF (J), 50V
C1225		BL Ceramic, 0.01mfd (K), 25V	C1295		Ceramic, 150pF (J), 50V
C1226		BL Ceramic, 0.047mfd (K), 25V	C1297		BL Ceramic, 0.01mfd (K), 25V
C1227		Elect., 47mfd (M), 16V	C1298		BL Ceramic, 0.01mfd (K), 25V
C1228		Elect., 10mfd (M), 16V	C1300		BL Ceramic, 0.022mfd (K), 25V
C1229		BL Ceramic, 0.01mfd (K), 25V	C1301		Elect., 47mfd (M), 16V
C1230		Ceramic, 240pF (J), 50V	C1302		BL Ceramic, 0.047mfd (K), 25V
C1231		Ceramic, 56pF (J), 50V	C1303		Elect., 4.7mfd (M), 25V
C1232		Ceramic, 390pF (J), 50V	C1304		Mylar, 0.0082mfd (M), 50V
C1233		BL Ceramic, 0.01mfd (K), 25V	C1305		Mylar, 0.022mfd (M), 50V
C1234		Ceramic, 18pF (J), 50V	C1306		Ceramic, 330pF (J), 50V
C1235		BL Ceramic, 0.047mfd (K), 25V	C1307		BL Ceramic, 0.01mfd (K), 25V
C1236		BL Ceramic, 0.047mfd (K), 25V	C1308		Ceramic, 330pF (J), 50V
C1237		BL Ceramic, 0.047mfd (K), 25V	C1309		Elect., 0.047mfd (M), 50V
C1238		Elect., 4.7mfd (M), 25V	C1310		BL Ceramic, 0.047mfd (K), 25V
C1239		Elect., 4.7mfd (M), 25V	C1311		BL Ceramic, 0.022mfd (K), 25V
C1240		BL Ceramic, 0.01mfd (K), 25V	C1312		Elect., 10mfd (M), 16V
C1241		BL Ceramic, 0.01mfd (K), 25V	C1313		BL Ceramic, 0.047mfd (K), 25V
C1242		Ceramic, 220pF (J), 50V	C1314		Elect., 47mfd (M), 16V
C1243		Ceramic, 27pF (J), 50V	C1315		BL Ceramic, 0.047mfd (K), 25V
C1244		Ceramic, 27pF (J), 50V	C1316		BL Ceramic, 0.047mfd (K), 25V
C1245		Ceramic, 56pF (J), 50V	C1318		BL Ceramic, 0.047mfd (K), 25V
C1246		Ceramic, 470pF (J), 50V			(RESISTORS)
C1247		BL Ceramic, 0.047mfd (K), 25V	R1201		750 ohms
C1248		Tantalum, 1.5mfd (J), 16V	R1202		330 ohms
C1249		Elect., 10mfd (M), 16V	R1203		56K ohms
C1251		BL Ceramic, 0.01mfd (K), 25V	R1204		10K ohms
C1252		Ceramic, 47pF (J), 50V, CH	R1205		47K ohms
C1253		BL Ceramic, 0.01mfd (K), 25V	R1206		2.2K ohms
C1255		BL Ceramic, 0.047mfd (K), 25V	R1207		390 ohms
C1256		Elect., 1mfd (M), 50V	R1208		390 ohms
C1257		Mylar, 0.012mfd (M), 50V	R1209		390 ohms
C1258		Elect., 1mfd (M), 50V	R1210		390 ohms
C1259		Ceramic, 15pF (J), 50V, CH	R1211		390 ohms
C1260		Mylar, 0.012mfd (M), 50V	R1212		2.2K ohms
C1261		BL Ceramic, 0.01mfd (K), 25V	R1213		390 ohms
C1264		BL Ceramic, 0.01mfd (K), 25V	R1214		22K ohms
C1265		Ceramic, 120pF (J), 50V	R1215		4.7K ohms
C1266		Ceramic, 4700pF (J), 50V	R1216		220K ohms
C1267		Ceramic, 220pF (J), 50V	R1217		1K ohms
C1268		Elect., 1mfd (M), 50V	R1218		4.7K ohms
C1269		BL Ceramic, 0.01mfd (K), 25V	R1219		220K ohms
C1270		Ceramic, 27pF (J), 50V CH	R1220		56K ohms

Schematic Location	Parts No.	Description	Schematic Location	Parts No.	Description
R1221		5.6K ohms	R1287		24K ohms
R1222		1K ohms	R1288		33K ohms
R1223		2.2K ohms	R1289		3.3K ohms
R1224		270 ohms	R1292		15K ohms
R1225		4.7K ohms	R1293		15K ohms
R1226		750 ohms	R1294		6.8K ohms
R1227		10K ohms	R1295		15K ohms
R1228		1.8K ohms	R1296		2.7K ohms
R1229		5.6K ohms	R1297		5.1K ohms
R1230		510 ohms	R1298		10K ohms
R1231		1K ohms	R1299		100K ohms
R1232		680 ohms	R1300		120K ohms
R1233		18K ohms	R1301		56K ohms
R1234		30K ohms	R1302		27K ohms
R1235		100 ohms	R1303		56K ohms
R1236		4.7K ohms	R1304		33K ohms
R1237		1K ohms	R1305		750 ohms
R1238		1K ohms	R1306		220 ohms
R1239		1K ohms	R1307		2.2K ohms
R1240		2.2K ohms	R1308		39 ohms
R1241		220K ohms	R1309		56K ohms
R1242		1.2K ohms	R1310		10K ohms
R1243		1K ohms	R1311		12K ohms
R1245		100K ohms	R1312		10K ohms
R1246		220K ohms	R1313		10K ohms
R1247		4.7K ohms	R1314		20K ohms
R1248		22K ohms	R1315		56K ohms
R1249		33K ohms	R1316		56K ohms
R1250		22K ohms	R1317		56K ohms
R1251		22K ohms	R1318		33K ohms
R1252		33K ohms	R1319		33K ohms
R1253		220 ohms	R1320		33K ohms
R1254		33K ohms	R1321		330 ohms
R1255		5.6K ohms	R1322		33K ohms
R1256		27K ohms	R1323		33K ohms
R1257		2.2K ohms	R1324		470 ohms
R1258		5.6K ohms	R1325		1.2K ohms
R1259		6.8K ohms	R1326		4.7K ohms
R1260		1K ohms	R1327		1.5K ohms
R1261		680 ohms	R1328		1K ohms
R1262		56K ohms	R1329		1K ohms
R1263		10K ohms	R1330		1.5K ohms
R1264		3.3K ohms	R1331		1K ohms
R1265		8.2K ohms	R1332		4.7K ohms
R1266		10K ohms	R1333		3K ohms
R1267		56K ohms	R1334		33K ohms
R1268		1K ohms	R1335		15K ohms
R1269		820 ohms	R1336		10K ohms
R1270		1.5K ohms	R1337		10K ohms
R1271		470 ohms	R1338		15K ohms
R1272		1K ohms	R1339		7.5K ohms
R1273		33K ohms	R1340		1K ohms
R1274		10K ohms	R1341		10K ohms
R1275		4.7K ohms	R1342		3K ohms
R1276		100 ohms	R1343		1K ohms
R1277		6.8K ohms	R1344		1K ohms
R1278		7.5K ohms	R1345		1.5K ohms
R1279		220K ohms	R1346		4.7M ohms
R1280		330 ohms	R1347		2.2K ohms
R1281		3K ohms	R1348		5.6K ohms
R1282		1.8K ohms	R1349		100K ohms
R1283		5.1K ohms	R1350		47K ohms
R1284		10K ohms	R1351		390 ohms
R1285		39K ohms	R1352		33K ohms
R1286		5.6K ohms	R1353		33K ohms

Schematic Location	Parts No.	Description	Schematic Location	Parts No.	Description
R1354		1K ohms	C3001		(CAPACITORS)
R1355		5.6K ohms	C3002		Elect., 100mfd (M), 16V
R1356		10K ohms	C3003		Elect., 47mfd (M), 16V
R1357		10K ohms	C3004		BL Ceramic, 0.1mfd (K), 25V
			C3005		BL Ceramic, 0.1mfd (K), 25V
		*SYSTEM CONTROL	C3008		BL Ceramic, 0.1mfd (K), 25V
		CIRCUIT . . . Location	C3009		Elect., 10mfd (M), 16V
		No.3001~	C3010		Elect., 0.1mfd (M), 16V
CF3001	4-953V-03400	Ceramic Oscillator, CSB400P	C3011		Elect., 10mfd (M), 16V
	143-2-368T-05400	Heat Sink (Q3019)	C3012		Elect., 2.2mfd (M), 16V
	143-0-236V-49800	Connector with Leads, 4 pin	C3013		Elect., 4.7mfd (M), 16V
			C3014		Ceramic, 330pF (J), 50V
		(IC's & TRANSISTORS)	C3015		Ceramic, 470pF (J), 50V
Q3001		IC, LM6402	C3016		Elect., 10mfd (K), 25V
Q3002		IC, LC7800	C3017		Elect., 10mfd (M), 25V
Q3003		IC, LC7800	C3020		Elect., 47mfd (M), 6.3V
Q3004		IC, TC4028B or MC14028B			BL Ceramic, 0.01mfd (K), 25V
Q3005		IC, LA7011			
Q3006		IC, BA6135			(RESISTORS)
Q3007		IC, LC4011B or TC4011B	R3001	4-957V-10313	R-pack, 10K ohms x 13
		or MC14011B	R3002	4-957V-10308	R-pack, 10K ohms x 8
Q3008		IC, TC4069B or MC14069B	R3003	4-957V-47208	R-pack, 4.7K ohms x 8
Q3009		IC, LB1274K	R3004	4-957V-47213	R-pack, 4.7K ohms x 13
Q3010		IC, LB1274K	R3010		1K ohms
Q3013		2SD439E or F	R3011		240K ohms
Q3014		2SC536E or F	R3012		220K ohms
Q3015		2SC536E or F	R3013		18K ohms
Q3017		2SA937Q or R	R3014		620 ohms
Q3018		2SA937Q or R	R3015		4.7M ohms
Q3019		2SD325E or F	R3016		330K ohms
Q3020		2SB632E or F	R3017		270K ohms
Q3021		2SB632E or F	R3018		100K ohms
Q3022		2SD894	R3019		100K ohms
Q3023		2SD894	R3020		1K ohms
Q3024		2SD894	R3021		1K ohms
Q3025		2SD894 or 2SD947	R3022		1K ohms
Q3026		2SD894	R3023		1K ohms
Q3027		2SD894 or 2SD947	R3024		1K ohms
Q3028		2SD894 or 2SD947	R3025		1K ohms
			R3026		1K ohms
		(DIODES)	R3027		1K ohms
D3002		Zener, GZA5.6U	R3028		1K ohms
D3003		DS135D	R3029		1K ohms
D3004		DS135D	R3030		1K ohms
D3005		DS135D	R3031		1K ohms
D3006		DS135D	R3032		1K ohms
D3007		DS135D	R3033		1K ohms
D3008		DS442	R3034		1K ohms
D3009		DS442	R3035		22K ohms
D3010		DS442	R3036		2.2K ohms
D3011		DS442	R3037		1M ohms
D3018		DS442	R3038		4.7K ohms
D3019		DS442	R3039		10K ohms
D3020		DS442	R3042		2.2K ohms
D3021		DS442	R3043		2.2K ohms
D3022		DS442	R3044		2.2K ohms
D3023		DS442	R3045		2.2K ohms
D3024		DS442	R3046		2.2K ohms
D3025		DS442	R3047		10K ohms
D3026		DS442	R3048		10K ohms
D3027		DS442	R3049		10K ohms
D3028		DS442	R3050		10K ohms
D3029		DS442	R3051		330 ohms
			R3052		270 ohms
			R3053		Non Flammable, 1 ohms

(4) MC-1 PCB. ELECTRICAL PARTS

Schematic Location	Parts No.	Description	Schematic Location	Parts No.	Description
R3054		470 ohms	Q3501		Transistor, 2SC536E or F
R3055		100K ohms	C3501		Elect. Capacitor (Super Small), 33mfd, 16V
R3056		100K ohms	C3502		Elect. Capacitor (Super Small), 10mfd, 16V
R3057		470 ohms			(RESISTORS)
R3058		22K ohms	R3501		330K ohms
R3059		22K ohms	R3502		100K ohms
R3060		22K ohms	R3503		1K ohms
R3061		22K ohms	R3504		10K ohms
R3062		10K ohms	R3505		100 ohms
R3063		33K ohms	R3506	4-221V-10700	Magnetic Sensor DM101A
R3064		33K ohms			
R3065		33K ohms			
R3066		33K ohms			
R3067		33K ohms			
R3068		33K ohms			
R3069		33K ohms			
R3070		33K ohms			
R3075		10K ohms			
R3076		12K ohms			
R3077		33K ohms			
R3078		2.2K ohms			
R3079		1K ohms			
R3080		100K ohms			
R3081		100K ohms			
R3089		10K ohms			

(5) SV-1 PCB. ELECTRICAL PARTS

Schematic Location	Parts No.	Description
VR4001	4-222V-62818	(VARIABLE RESISTORS) 68K ohms
VR4002	4-222V-62818	68K ohms
VR4003	4-222V-62817	47K ohms
VR4004	4-222V-63118	Metal Glaze, 100K ohms
VR4005	4-222V-62818	68K ohms
VR4006	4-222V-63117	Metal Glaze, 47K ohms
Q4001		(IC's & TRANSISTORS) IC, CX-186
Q4003		2SA933Q or R
Q4004		2SD400F or 2SD863F
Q4005		IC, CX-143A
Q4006		2SC536F, or 2SC1815GR or 2SC2603F
Q4007		2SA933Q or R
Q4008		2SA933Q or R
Q4009		IC, TC4016B or CD4066B or MB84066B
Q4010		2SA933Q or R
Q4011		2SA933Q or R
Q4012		IC, TA7340P
Q4013		IC, BA222
Q4014		2SC1634-7
Q4015		2SD1010R or S
Q4016		2SC536F or 2SC1815GR or 2SC2603F
Q4017		IC, NJM2904D
Q4018		2SC536F or 2SC1815GR or 2SC2603F
Q4019		2SC536F or 2SC1815GR or 2SC2603F
D4001		(DIODES) 1S1555 or DS442 or 1S133
D4002		1S1555 or DS442 or 1S133
D4003		1S1555 or DS442 or 1S133
D4004		1S1555 or DS442 or 1S133
D4005		Zener, XZ100
D4006		1S1555 or DS442 or 1S133
D4007		1S1555 or DS442 or 1S133
D4008		Zener, GZA12X

(3) SY-2 PCB. ELECTRICAL PARTS

Schematic Location	Parts No.	Description
SW3401	143-2-374T-01200	Panel, Control LED's
SW3402	4-231V-64600	PLAY Switch
SW3403	4-231V-64600	STOP Switch
SW3404	4-231V-64600	REW Switch
SW3405	4-231V-64600	F. FWD Switch
SW3406	4-231V-64600	PAUSE Switch
SW3407	4-231V-64600	EJECT Switch
SW3408	4-231V-64700	REC Switch
		REC LOCK Switch
D3401		(DIODES) LED, AR2432B ... DEW light
D3402		LED, AR2432B ... REC light
D3403		LED, AR2432B ... REW light
D3404		LED, AR2432B ... PLAY light
D3405		LED, AR2432B ... F. FWD light
D3406		LED, AR-2432B ... PAUSE light
R3401		(RESISTORS) 470 ohms
R3402		470 ohms
R3403		470 ohms
R3404		470 ohms
R3405		470 ohms
R3406		470 ohms

Schematic Location	Parts No.	Description	Schematic Location	Parts No.	Description
		(CAPACITORS)			
C4001		Mylar, 0.068mfd (J), 50V	R4007		6.8K ohms
C4002		Elect., 10mfd (M), 16V	R4008		390K ohms
C4003		Mylar, 0.018mfd (J), 50V	R4009		4.7M ohms
C4004		Mylar, 0.018mfd (J), 50V	R4010		56K ohms
C4005		Tantalum, 0.22mfd (K), 35V	R4011		1.8K ohms
C4006		Mylar, 1000pF (J), 50V	R4012		10K ohms
C4007		Mylar, 0.047mfd (J), 50V	R4013		22K ohms
C4008		NP. Elect., 2.2mfd (M), 25V	R4014		18K ohms
C4009		Tantalum, 0.33mfd (K), 35V	R4015		39K ohms
C4010		Mylar, 0.033mfd (J), 50V	R4016		6.8K ohms
C4011		Aluminium, 0.22mfd (M), 16V	R4017		6.8K ohms
or		Tantalum, 0.22mfd (K), 35V	R4018		33K ohms
C4012		Elect., 2.2mfd (M), 50V	R4019		10K ohms
C4013		Mylar, 1000pF (J), 50V	R4020		120K ohms
C4014		Mylar, 0.1mfd (J), 50V	R4021		33K ohms
C4015		Mylar, 0.047mfd (J), 50V	R4022		470 ohms
C4016		Mylar, 0.082mfd (J), 50V	R4023		Metal Glaze, 27K ohms, $\pm 2\%$
C4017		Polypropylene, 0.1mfd (J), 100V	R4024		33K ohms
C4018		Mylar, 0.033mfd (J), 50V	R4028		10K ohms
C4019		Elect., 33mfd (M), 16V	R4029		47K ohms
C4020		Elect., 220mfd (M), 16V	R4030		47K ohms
C4021		Polypropylene, 0.082mfd (J), 100V	R4031		220 ohms
C4022		Mylar, 4700pF (J), 50V	R4032		Metal Glaze, 270K ohms, $\pm 2\%$
C4023		Mylar, 0.1mfd (J), 50V	R4033		33K ohms
C4024		Aluminium, 0.47mfd (M), 16V	R4034		47K ohms
or		Tantalum, 0.47mfd (K), 35V	R4035		120K ohms
C4025		Mylar, 0.047mfd (J), 50V	R4036		560 ohms
C4026		Elect., 47mfd (M), 16V	R4037		4.7K ohms
C4027		NP Elect., 2.2mfd (M), 25V	R4038		8.2K ohms
C4028		Elect., 1mfd (M), 50V	R4039		47K ohms
C4029		Tantalum, 0.47mfd (K), 35V	R4040		180K ohms
C4030		Tantalum, 0.47mfd (K), 35V	R4041		1K ohms
C4031		Tantalum, 0.47mfd (K), 35V	R4042		56K ohms
C4032		Ceramic, 1000pF (J), 50V	R4043		1K ohms
C4033		Mylar, 0.047mfd (J), 50V	R4044		18K ohms
C4034		NP Elect., 2.2mfd (M), 25V	R4045		2.2K ohms
C4035		Mylar, 0.047mfd (J), 50V	R4046		1K ohms
C4036		Tantalum, 0.47mfd (K), 35V	R4047		100K ohms
C4037		Ceramic, 1000pF (J), 50V	R4048		100K ohms
C4038		NP Elect., 1mfd (M), 25V	R4049		10K ohms
C4039		Elect., 1mfd (M), 50V	R4050		33K ohms
C4040		Elect., 1mfd (M), 50V	R4051		1K ohms
C4041		Elect., 4.7mfd (M), 25V	R4052		1K ohms
C4042		Tantalum, 0.33mfd (K), 35V	R4053		47K ohms
C4043		Elect., 33mfd (M), 16V	R4054		47K ohms
C4044		Elect., 22mfd (M), 16V	R4055		5.1M ohms
C4045		Elect., 47mfd (M), 16V	R4056		390K ohms
C4046		Elect., 1mfd (M), 50V	R4057		10K ohms
C4047		NP Elect., 1mfd (M), 25V	R4058		10K ohms
C4048		Elect., 330mfd (M), 16V	R4059		33K ohms
C4049		Elect., 47mfd (M), 16V	R4060		10K ohms
C4050		Elect., 220mfd (M), 16V	R4061		2.2K ohms
C4051		Mylar, 0.022mfd (J), 50V	R4062		18K ohms
C4052		Mylar, 0.033mfd (J), 50V	R4064		5.6K ohms
C4053		Elect., 100mfd (M), 16V	R4065		10K ohms
		(RESISTORS)	R4066		1K ohms
R4001		33K ohms	R4067		1K ohms
R4002		33K ohms	R4069		4.7K ohms
R4003		33K ohms	R4070		10K ohms
R4004		5.6K ohms	R4071		10K ohms
R4005		33K ohms	R4072		47K ohms
R4006		6.8K ohms	R4073		5.6K ohms
			R4074		1.2K ohms
			R4075		22K ohms
			R4076		10K ohms

Schematic Location	Parts No.	Description
R4077		180 ohms
R4078		12K ohms
R4079		82K ohms
R4080		47K ohms
R4081		27K ohms
R4082		10K ohms
R4083		1K ohms
R4084		4.7K ohms
R4085		1K ohms
R4086		1.8K ohms
R4087		22K ohms
R4088		10K ohms
R4089		5.6K ohms
R4090		39K ohms
R4091		3.3K ohms
R4092		4.7K ohms
R4093		330 ohms
R4094		1K ohms
R4095		5.6K ohms
R4096		6.8K ohms
R4097		6.8K ohms
R4098		1.5K ohms
R4099		470K ohms
R4100		10K ohms
R4101		100K ohms
R4102		10K ohms
R4103		10K ohms
R4104		100K ohms
R4105		100K ohms
R4106		1K ohms
R4107		10K ohms
R4108		10K ohms
R4109		47K ohms
R4110		33K ohms
R4111		10K ohms
R4112		56K ohms
R4113		4.7K ohms
R4114		2.2K ohms
R4115		1K ohms
R4116		1K ohms
R4117		1K ohms

(6) SV-2 PCB. ELECTRICAL PARTS Capstan Motor

Schematic Location	Parts No.	Description
Q4301		(IC's & TRANSISTORS)
Q4302		Magnetic Sensor, H200A
Q4303		Magnetic Sensor, H200A
Q4304		Magnetic Sensor, H200A
Q4305		IC, PD102
Q4306		2SA1115E or F or 2SA608E or F or 2SA733P or Q or 2SA1048Y or GR
Q4307		2SA1115E or F or 2SA608E or F or 2SA733P or Q or 2SA1048Y or GR

Schematic Location	Parts No.	Description
Q4308		2SA1115E or F or 2SA608E or F or 2SA733P or Q or 2SA1048Y or GR
Q4309		2SC536E or F or G or 2SC2603E or F or G or 2SC945K or P or Q or 2SC458C or D or 2SC2458Y or GR
D4301		(DIODE) Zener, RD5.1EL1 or HZ5C2
C4301		(CAPACITORS) BL Ceramic, 0.01mfd (M), 16V
C4302		BL Ceramic, 0.047mfd (M), 16V
C4303		BL Ceramic, 0.047mfd (M), 16V
C4304		Elect., 10mfd (M), 25V
C4305		Elect., 10mfd (M), 25V
C4306		Elect., 10mfd (M), 25V
C4307		Elect., 22mfd (M), 16V
R4301		(RESISTORS) Non Flammable, 2.2 ohms
R4302		220K ohms
R4303		33K ohms
R4304		47K ohms
R4305		47K ohms
R4306		47K ohms
R4307		47K ohms
R4308		2.7K ohms
R4309		4.7K ohms
R4310		10K ohms
R4311		2.2K ohms
R4312		1.2K ohms
R4313		100K ohms
R4314		10K ohms
R4315		3.9K ohms

(7) PW-1 PCB. ELECTRICAL PARTS

Schematic Location	Parts No.	Description
T5001 or	143-2-368F-04800 143-2-322T-19100 143-2-322T-19300 143-2-322T-19200 △ 4-234V-15418 △ 4-234V-12509 143-2-383T-03100	Heat Sink, Transistors & Diode Shield Plate, Cover Shield Frame, Parts Side Shield Plate, Pattern Side Fuse, 1.6A Fuse, 1.6A Fuse Holder (2 used)
VR5001 or	4-222V-62504	(VARIABLE RESISTORS) 1K ohms
VR5002 or	4-222V-62502	1K ohms
VR5003 or	4-222V-62605	2K ohms
	4-222V-62500	2K ohms
	4-222V-62504	1K ohms
	4-222V-62502	1K ohms

Schematic Location	Parts No.	Description
L5001 L5002 L5003 L5004 L5005	4-253V-93400 4-253V-95300 4-253V-88622 4-253V-95400 4-471V-10200	(COILS) HF Choke, 200 μ H, HF Choke, 1.5mH, HF Choke, 5.6 μ H, HF Choke, 10 μ H, Core
Q5001 Q5002 Q5003 Q5004 Q5005 Q5006 Q5007 Q5008 Q5009 Q5010 Q5011 Q5013		(IC's & TRANSISTORS) IC, TL494CN IC, TL494CN 2SB828R or S 2SB825Q or R or S 2SC19830 2SC536E or F or G 2SA608E or F or G 2SC536E or F or G 2SC536E or F or G 2SB698D or E or F 2SC536E or F or G 2SD863D or E or F
D5001 D5002 D5003 D5004 D5005 D5006 D5007 D5008 D5009 D5010		(DIODES) DBA60B or C or S5 VB10 or RB601 DS135D or C S5KC20R or CTU22R BZ150 BZ 182 XZ062 or GZA6.2Y XZ127 or GZA13X 1S2473 XZ084 or GZA8.2Z 1S2473 or 1S1555
C5001 C5002 C5003 C5004 C5005 C5006 C5007 C5008 C5009 C5010 C5011 C5012 C5013 C5014 C5016 C5017		(CAPACITORS) Elect., 2200mfd (M), 35V Elect., 47mfd (M), 100V Ceramic, 0.01mfd (K), 50V Ceramic, 0.01mfd (K), 50V Ceramic, 0.01mfd (K), 50V Ceramic, 0.01mfd (K), 50V Elect., 470mfd (M), 16V Elect., 100mfd (M), 16V Elect., 47mfd (M), 35V Elect., 2.2mfd (M), 50V Elect., 47mfd (M), 16V Elect., 100mfd (M), 25V Mylar, 0.001mfd (K), 50V Elect., 330mfd (M), 25V Elect., 3.3mfd (M), 50V Ceramic, 0.01mfd (K), 50V
R5001 R5002 R5003 R5004 R5005 R5006 R5007 R5008 R5009 R5010 R5011		(RESISTORS) Metal Glaze, 1K ohms, 1W Fusible, 33 ohms 47 ohms Metal Glaze, 270 ohms, 1W 100K ohms 6.8K ohms 560 ohms 15K ohms Metal Glaze, 0.22 ohms, 1/2W Metal Glaze, 0.22 ohms, 1/2W 8.2K ohms

Schematic Location	Parts No.	Description
R5012 R5013 R5014 R5015 R5016 R5017 R5018 R5019 R5020 R5021 R5022 R5023 R5024 R5025 R5026 R5027 R5028 R5029 R5030 R5031 R5032 R5033 R5034 R5036 R5037 R5038 R5040		1.8K ohms 4.7K ohms 4.7K ohms 10K ohms 47K ohms 33K ohms 100K ohms 270 ohms 8.2K ohms 1.5K ohms 1K ohms 2.2K ohms 47 ohms 1K ohms 100K ohms 47K ohms 820 ohms 82K ohms Metal Glaze, 0.22 ohms, 1/2W 12K ohms 1.8K ohms 4.7K ohms 4.7K ohms 1.5K ohms 12K ohms 470 ohms 10 ohms

(8) PW-2 PCB. ELECTRICAL PARTS

Schematic Location	Parts No.	Description
F5201	Δ 4-243V-15414 143-2-383T-03100 143-2-135T-16300	Fuse, 630mA Fuse Holder (2 used) Fuse Cover
L5201 or C5201 or	Δ 4-252V-11600 Δ 4-252V-11800 Δ 4-223V-18900 Δ 4-223V-20200	LF Choke Coil LF Choke Coil Elect., Capacitor, 0.1 mfd, 250V Elect., Capacitor, 0.1 mfd, 250V

(9) TN-1 PCB. ELECTRICAL PARTS

Schematic Location	Parts No.	Description
VR6001 VR6002 VR6003	4-222V-65812 4-222V-65805 4-222V-65806	(VARIABLE RESISTORS) 1M ohms 5K ohms 10K ohms
F6001 F6002 F6003 F6004	4-953V-04000 4-953V-00100 4-953V-00300 4-953V-04100	(FILTERS) Filter Filter Filter Filter

Schematic Location	Parts No.	Description
		(COIL TRANSFORMERS & COILS)
T6001	4-256V-24700	IF Trans.
T6002	4-256V-24800	IF Trans.
L6001	4-253V-94700	HF Choke, 0.68 μ H
L6002	4-253V-94800	HF Choke, 0.83 μ H
L6003	4-253V-95100	HF Choke, 1.3 μ H
L6005	4-253V-85914	HF Choke, 12 μ H
L6006	4-253V-85912	HF Choke, 8.2 μ H
L6007	4-253V-85915	HF Choke, 15 μ H
L6008	4-253V-85912	HF Choke, 8.2 μ H
		(IC's & TRANSISTORS)
Q6001		2SC2216
Q6002		2SC536E or F
Q6003		2SC536E or F
Q6004		2SD545E or F
Q6005		IC, TA7607AP
Q6006		IC, LA1365
		(CAPACITORS)
C6001		Ceramic, 0.01mfd (P), 50V
C6002		Ceramic, 0.01mfd (P), 50V
C6003		Elect., 47mfd (M), 25V
C6005		Elect., 0.47mfd (M), 25V
C6006		Ceramic, 0.01mfd (P), 50V
C6008		Ceramic, 0.01mfd (P), 50V
C6009		Ceramic, 1000pF (K), 50V
C6010		Ceramic, 2pF ($\pm$ 0.5pF), 50V, CH
C6011		Ceramic, 56pF (J), 50V, RH
C6012		Ceramic, 82pF (J), 50V, CH
C6013		Ceramic, 2pF ($\pm$ 0.5pF), 50V, CH
C6014		Ceramic, 12pF (J), 50V, CH
C6015		Ceramic, 0.01mfd (P), 50V
C6016		Elect., 2.2mfd (M), 25V
C6017		Ceramic, 1000pF (K), 50V
C6018		Ceramic, 0.01mfd (P), 50V
C6019		Elect., 1mfd (M), 25V
C6020		Ceramic, 47pF (J), 50V
C6021		Ceramic, 47pF (J), 50V
C6022		Elect., 2.2mfd (M), 25V
C6023		Ceramic, 0.01mfd (P), 50V
C6024		Elect., 100mfd (M), 25V
C6025		Mylar, 6800pF (K), 50V
C6026		Ceramic, 68pF (J), 50V, RH
C6027		Elect., 4.7mfd (M), 25V
C6028		Ceramic, 4pF ($\pm$ 0.25pF), 50V, CH
C6029		Elect., 470mfd (M), 10V
C6030		Ceramic, 0.01mfd (P), 50V
		(RESISTORS)
R6001		180 ohms
R6002		5.6K ohms
R6004		390 ohms
R6005		1K ohms
R6006		33 ohms
R6007		820K ohms
R6008		820 ohms
R6009		5.6K ohms
R6010		1K ohms
R6011		1K ohms
R6012		220 ohms
R6013		1K ohms
R6014		1K ohms
R6015		100K ohms
R6016		150K ohms

Schematic Location	Parts No.	Description
R6017		2.7K ohms
R6018		1K ohms
R6019		270 ohms
R6020		2.2K ohms
R6021		1K ohms
R6022		150 ohms
R6024		100 ohms
R6025		560 ohms
R6026		Non Flammable, 33 ohms
R6027		680 ohms
R6028		1K ohms
R6029		1.2K ohms
R6030		12K ohms
R6031		1K ohms

(10) TN-2 PCB. ELECTRICAL PARTS

Schematic Location	Parts No.	Description
VR6201	4-222V-14000	Channel Select VR.
SW6201	4-231V-19000	AFT Switch
		(TRANSISTORS)
Q6201		2SC536E or F
Q6202		2SC536E or F
Q6203		2SA984E or F
Q6204		2SA984E or F
		(DIODES)
D6201		DS442X or 1SS132
D6202		DS442X or 1SS132
D6203		DS442X or 1SS132
D6204		DS442X or 1SS132
D6205		DS442X or 1SS132
D6206		DS442X or 1SS132
D6207		DS442X or 1SS132
D6208		DS442X or 1SS132
D6215		DS442X or 1SS132
D6216		DS442X or 1SS132
D6217		DS442X or 1SS132
D6218		DS442X or 1SS132
D6219		DS442X or 1SS132
D6220		DS442X or 1SS132
D6221		DS442X or 1SS132
D6222		DS442X or 1SS132
D6229		μ PC574J
D6230		1S1555 or 1S2473
D6232		1S1555 or 1S2473
		(CAPACITORS)
C6203		Elect., 22mfd (M), 50V
C6204		Ceramic, 0.01mfd (Z), 50V
C6205		Elect., 100mfd (M), 16V
C6206		Elect., 100mfd (M), 16V

Schematic Location	Parts No.	Description
R6201		(RESISTORS) 470K ohms
R6202		39K ohms
R6203		1K ohms
R6204		100K ohms
R6205		1M ohms
R6206		10K ohms
R6207		15K ohms
R6208		2.2K ohms
R6209		2.2K ohms
R6210		2.2K ohms
R6211		15K ohms

(11) TN-3 PCB. ELECTRICAL PARTS

Schematic Location	Parts No.	Description
SW6301	4-231V-63500	Channel Select Switch
SW6302	4-231V-64000	POWER ON/TIMER/STAND BY Switch
	143-2-374T-01000	Panel, Channel Lights
D6301		(DIODES) LED, PR5704S ... Channel light
D6302		LED, PR5704S ... Channel light
D6303		LED, PR5704S ... Channel light
D6304		LED, PR5704S ... Channel light
D6305		LED, PR5704S ... Channel light
D6306		LED, PR5704S ... Channel light
D6307		LED, PR5704S ... Channel light
D6308		LED, PR5704S ... Channel light
D6309		LED, PR5704S ... POWER ON light
D6310		LED, PR5704S ... TIMER light
R6301		(RESISTORS) 1K ohms
R6302		1K ohms
R6303		1K ohms
R6306		33K ohms
R6307		560 ohms

(12) TM-1 PCB. ELECTRICAL PARTS

Schematic Location	Parts No.	Description
CF7001	4-202V-12700	Digital Display
SW7001	4-953V-03400	Ceramic Filter
SW7002	4-231V-64500	MEMORY Switch
SW7003	4-231V-64400	CLOCK SET Switch
SW7004	4-231V-64400	REC START Switch
SW7005	4-231V-64400	REC STOP Switch
SW7006	4-231V-64400	REC DAY Switch
SW7007	4-231V-64400	DAY/HOUR Switch
		MIN Switch

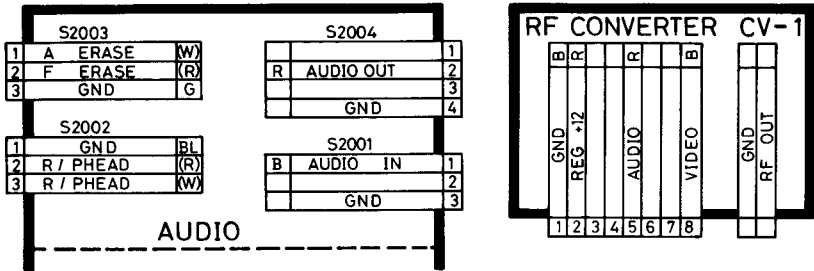
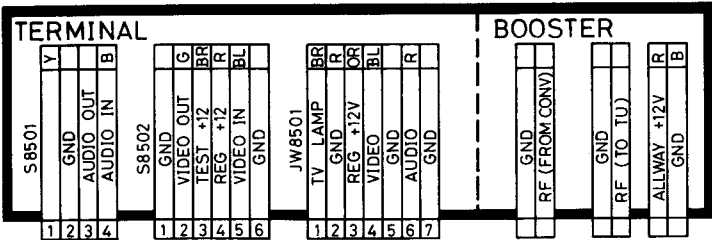
Schematic Location	Parts No.	Description
Q7001		(IC's & TRANSISTORS) IC, μ PD552C-083
Q7002		IC, μ PC393C
Q7003		2SB632E or F
Q7005		2SC536E or F
Q7006		2SC536E or F
Q7007		2SA608E or F
D7001		(DIODE) DS442 or 1S2473 or 1S1555
D7002		DS442 or 1S2473 or 1S1555
D7003		DS442 or 1S2473 or 1S1555
D7004		DS442 or 1S2473 or 1S1555
D7005		DS442 or 1S2473 or 1S1555
D7006		DS442 or 1S2473 or 1S1555
D7007		DS442 or 1S2473 or 1S1555
D7008		Zener, RD6.8EB2
D7009		Zener, RD11EB2
D7010		DS442 or 1S2473 or 1S1555
C7001		(CAPACITORS) Ceramic, 0.01mfd (M), 25V
C7002		Ceramic, 0.01mfd (M), 25V
C7003		Ceramic, 0.022mfd (M), 25V
C7004		Ceramic, 0.022mfd (M), 25V
C7005		Mylar, 0.082mfd (M), 50V
C7006		Elect., 100mfd (M), 25V
C7007		Elect., 47mfd (M), 25V
C7008		Ceramic, 470pF (K), 25V
C7009		Ceramic, 120pF (K), 25V
C7010		Ceramic, 0.022mfd (M), 25V
C7011		Elect., 33mfd (K), 16V
R7001		(RESISTORS) 2.2K ohms
R7002		5.6K ohms
R7003		27K ohms
R7004		27K ohms
R7005		220K ohms
R7006		220K ohms
R7007		27K ohms
R7008		220K ohms
R7009		2.2K ohms
R7010		2.2K ohms
R7011		10K ohms
R7012		27K ohms
R7013		10K ohms
R7014		1K ohms
R7015		1M ohms
R7016		10K ohms
R7017		10K ohms
R7018		10K ohms
R7019		10K ohms
R7020		18K ohms
R7021		5.6K ohms
R7022		33K ohms
R7023		100K ohms
R7024		100K ohms
R7025		10K ohms
R7026	4-956V-10408	R-pack, 100K ohms $\times 8$
R7027	4-956V-33305	R-pack, 33K ohms $\times 5$
R7028	4-956V-33303	R-pack, 33K ohms $\times 3$
R7029		10K ohms
R7030		10K ohms
R7031		33K ohms
R7032		10K ohms

VBS-7500(CONTINENT)
 VBS-7500(Indonesia)
 VBS-7500S
 VBS-9900
 VBS-9900S
 VTC 5300P(CONTINENT)
 VTC 5300P(U·K)
 VTC 5300P(H·K)
 VTC 5300P(South Africa)
 VTC 5300P(Australia)
 VTC 5300P(Indonesia)
 VTC 5300PB
 VTC 5300P(Ireland)

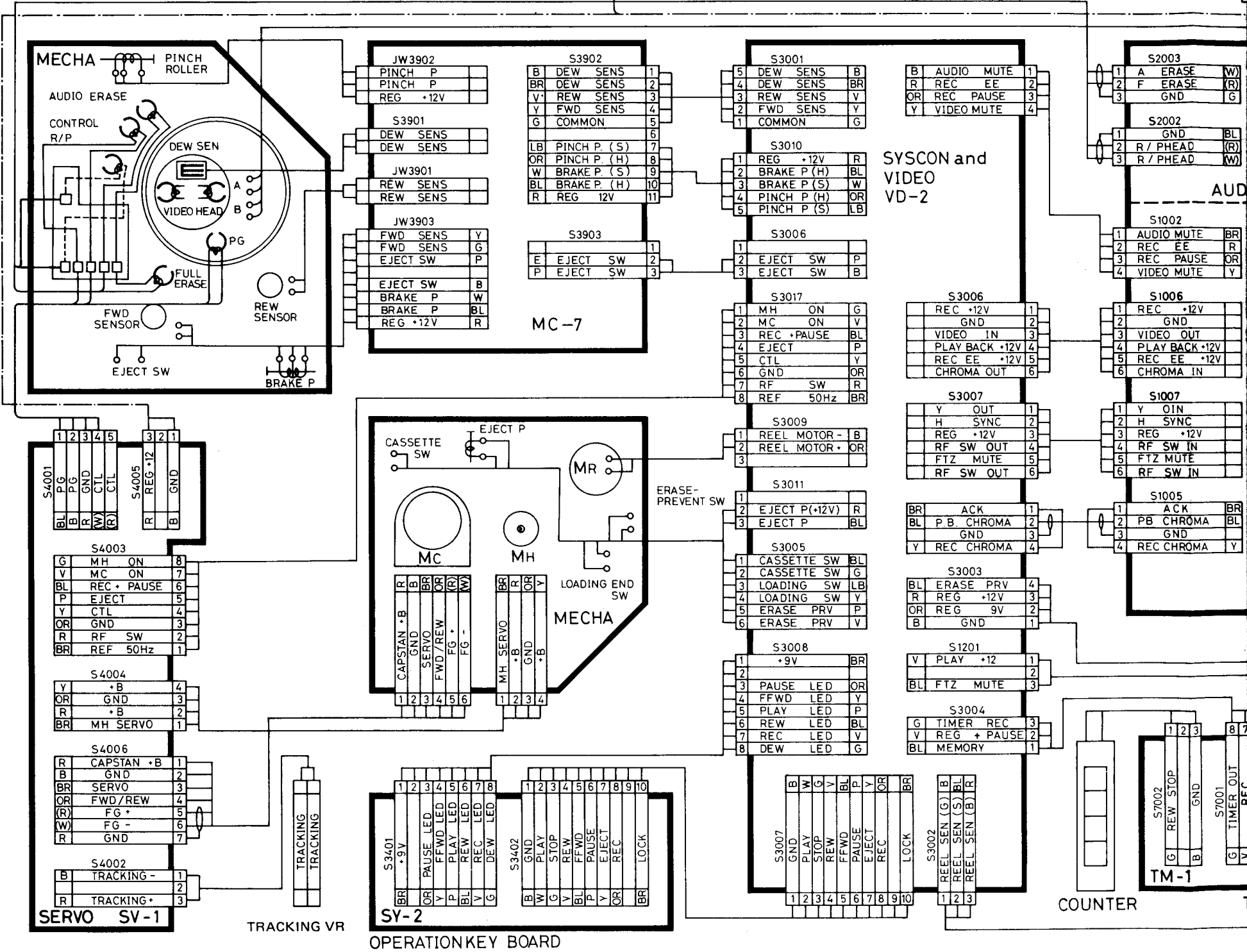
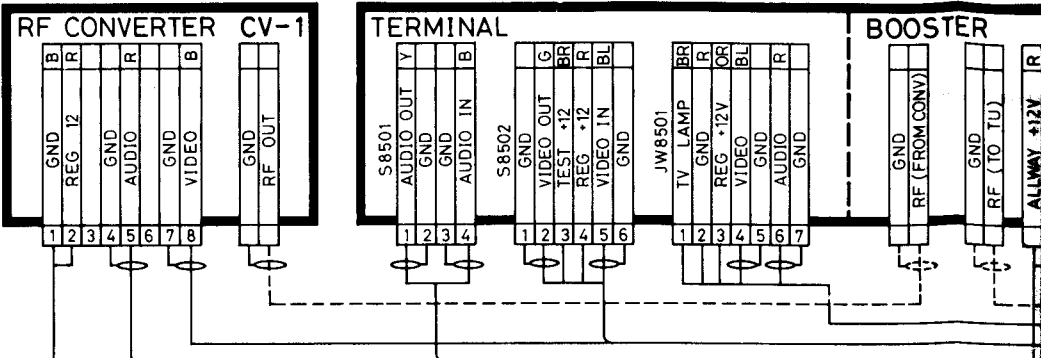
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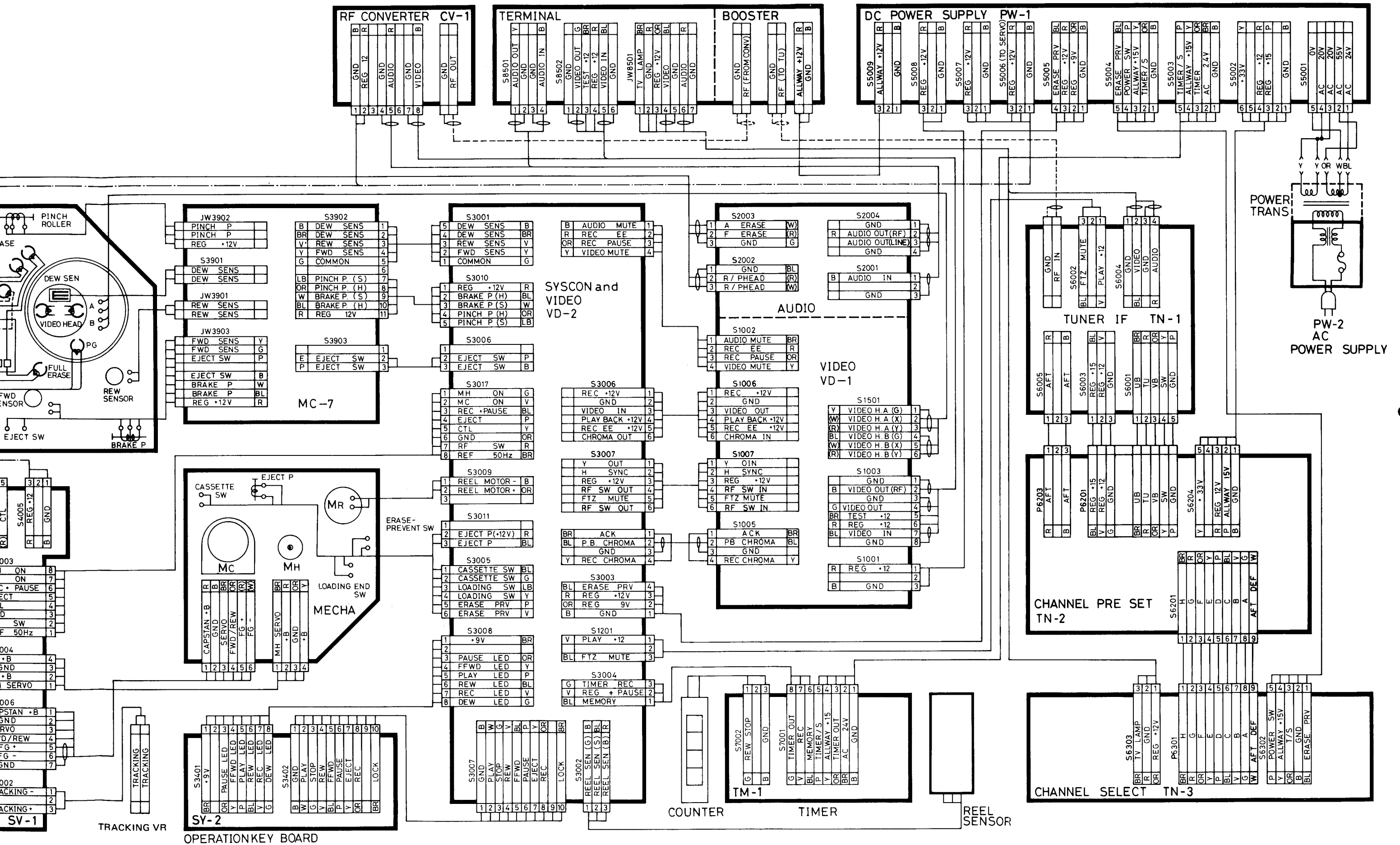
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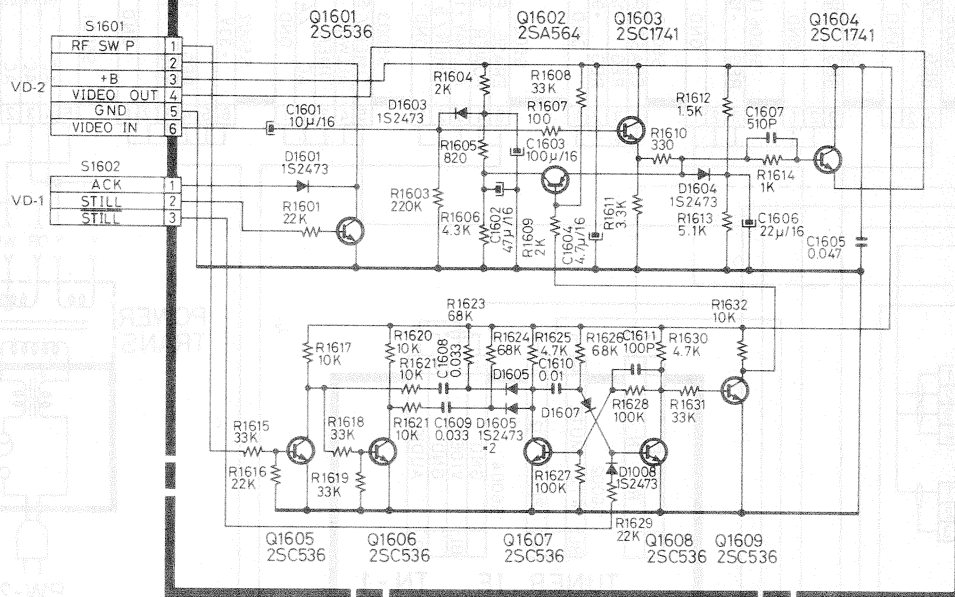
OVER ALL WIRING DIAGRAM



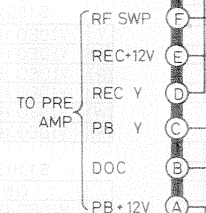
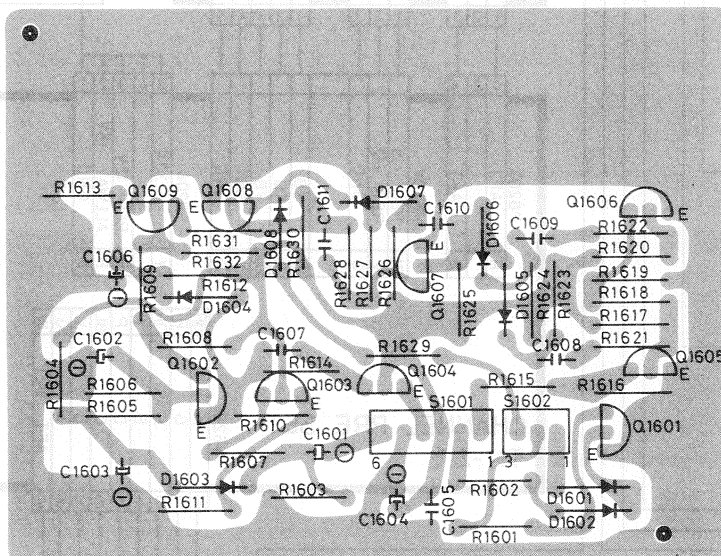
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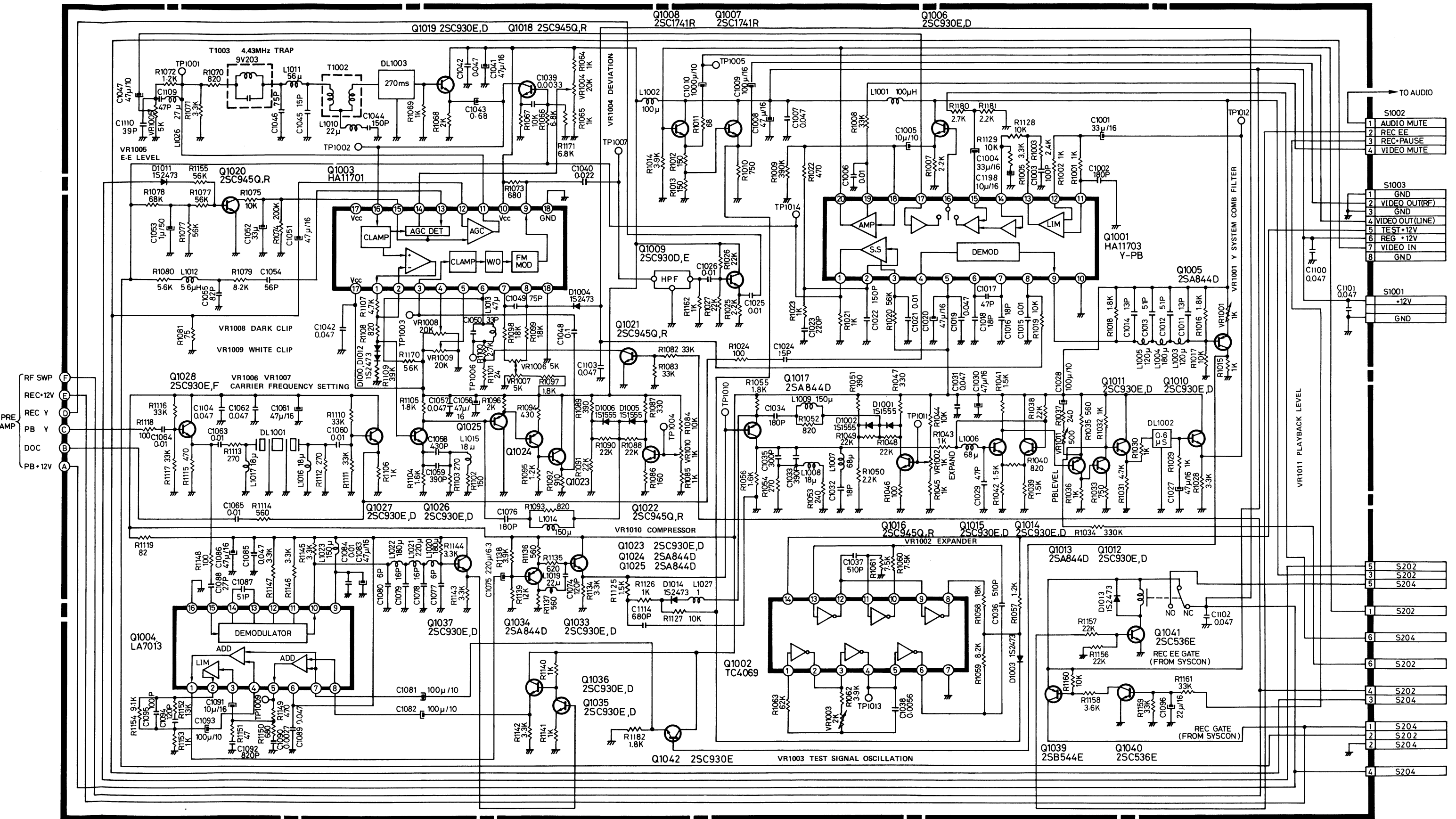
P.C.B. VD-3 VIDEO (3) CIRCUIT (STILL)



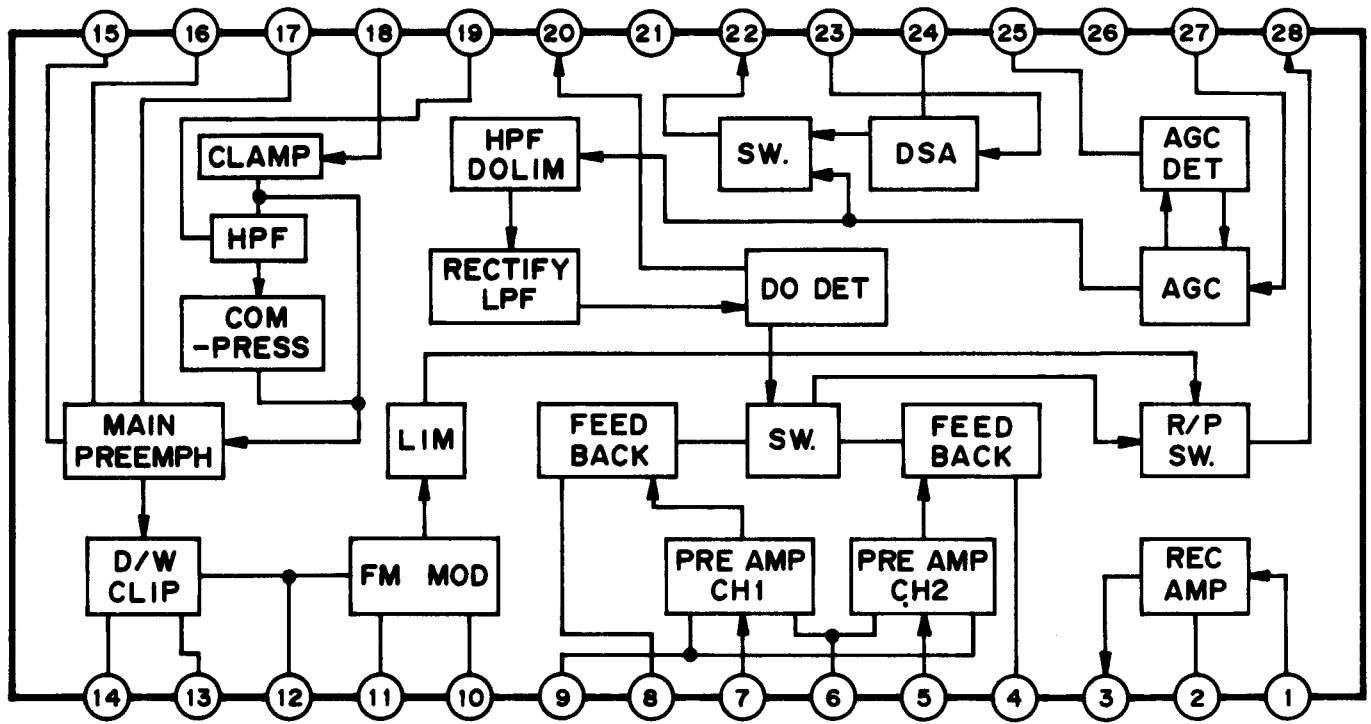
P.C.B. VD-3 VIDEO (3) CIRCUIT (STILL)



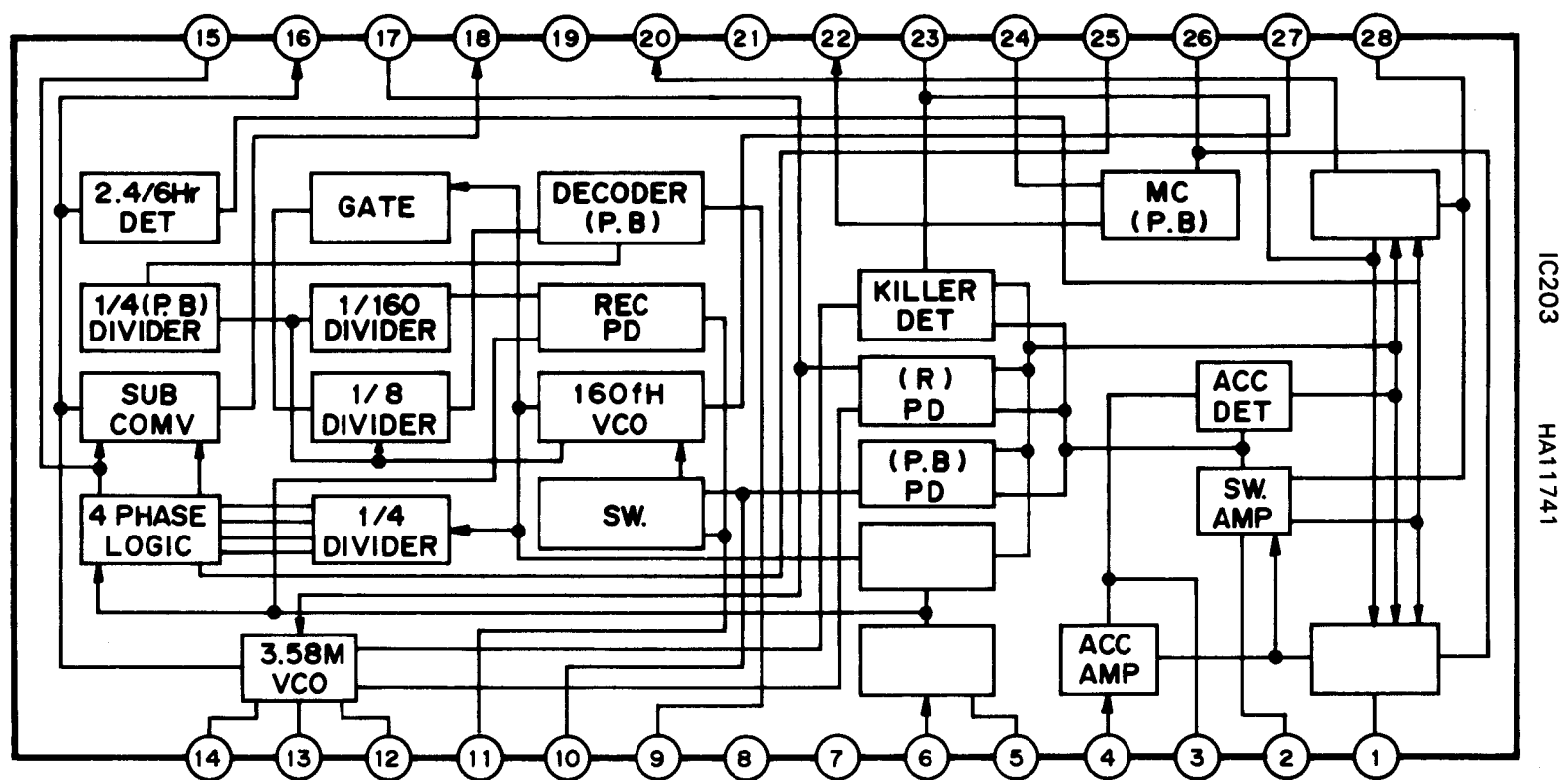
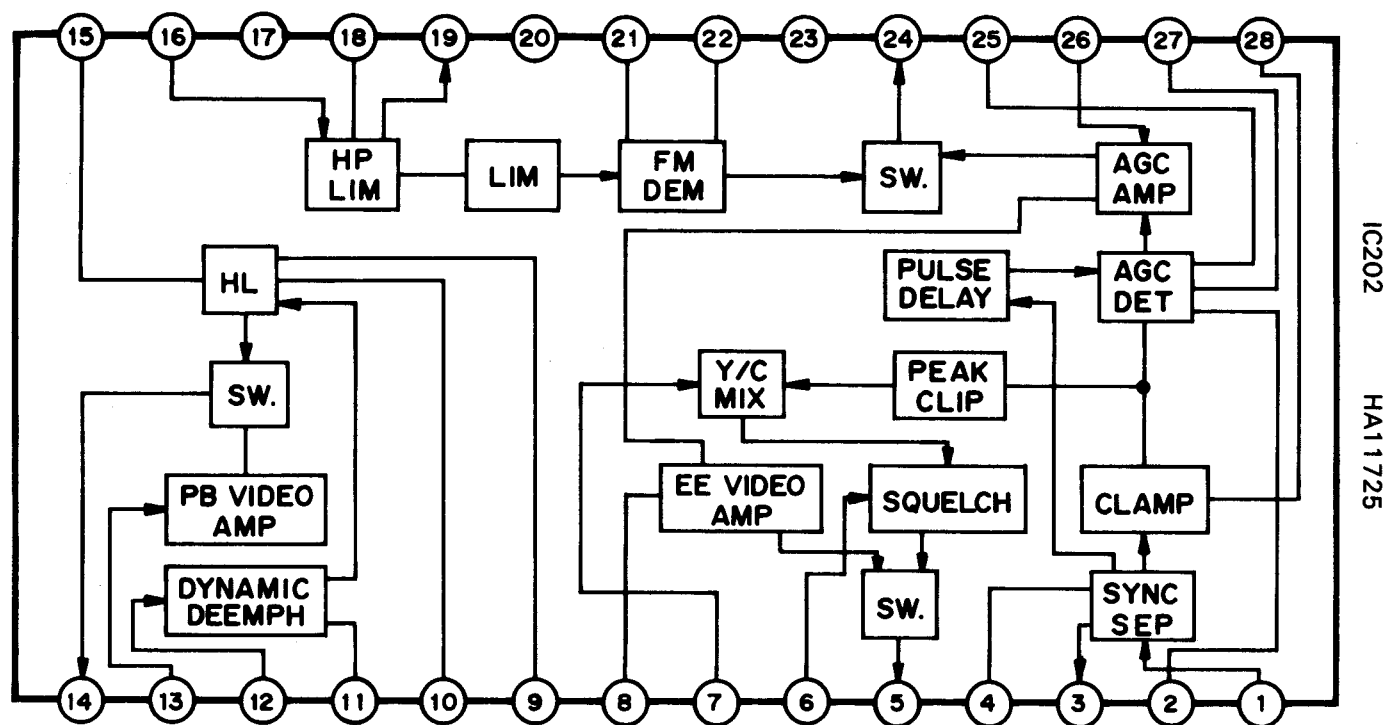
P.C.B. VD-1 VIDEO (1) CIRCUIT



VIDEO CIRCUIT IC BLOCK DIAGRAM



IC201 HA11724



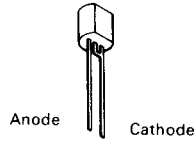
TERMINAL VIEW



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2SC2458



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MPC574J



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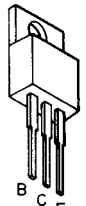
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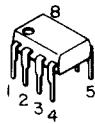
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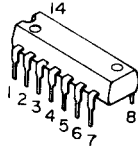
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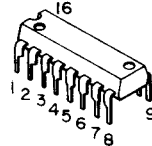
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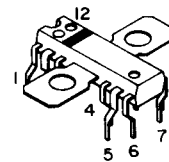
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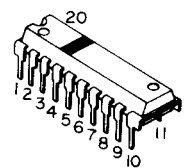
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LC4081



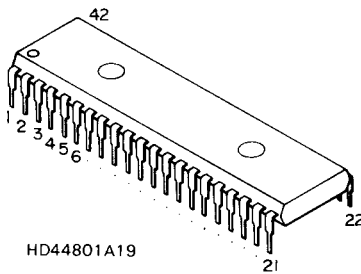
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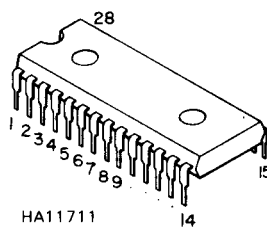
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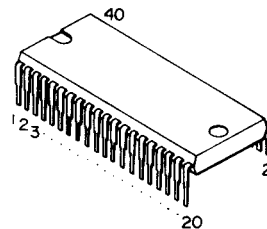
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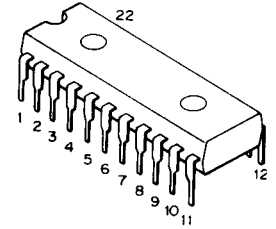
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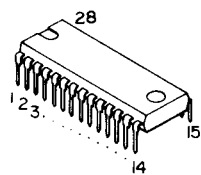
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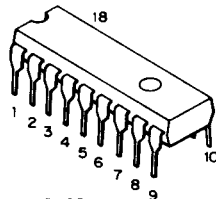
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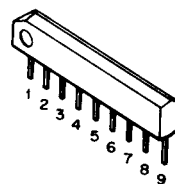
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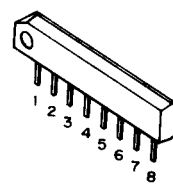
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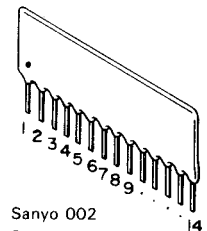
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LA7016



Sanyo 002
Sanyo 003
Sanyo 004

Cathode



Anode

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EQA02-08
EQA02-09
EQA02-10
EQA02-16

EQA02-23
EQA02-35
GZA5.1
GZA6.2
GZA8.2
GZA10
GZA16
GZA22
GZA36
GZA39E
GZA91
RD6.2E
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RD11E
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RD24E
RD39E
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Cathode



Anode

DS135E
ERB12-02

Cathode

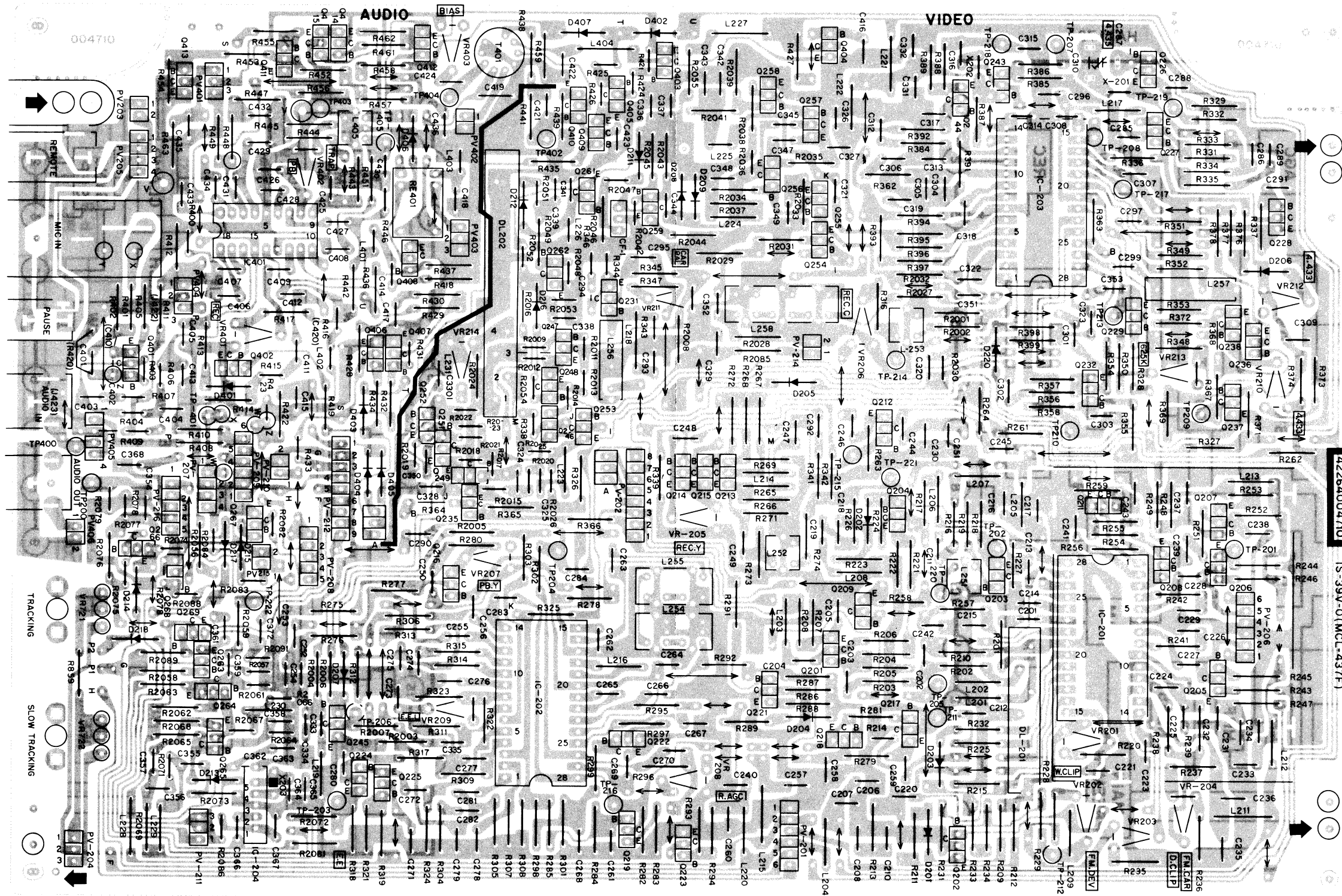


Anode

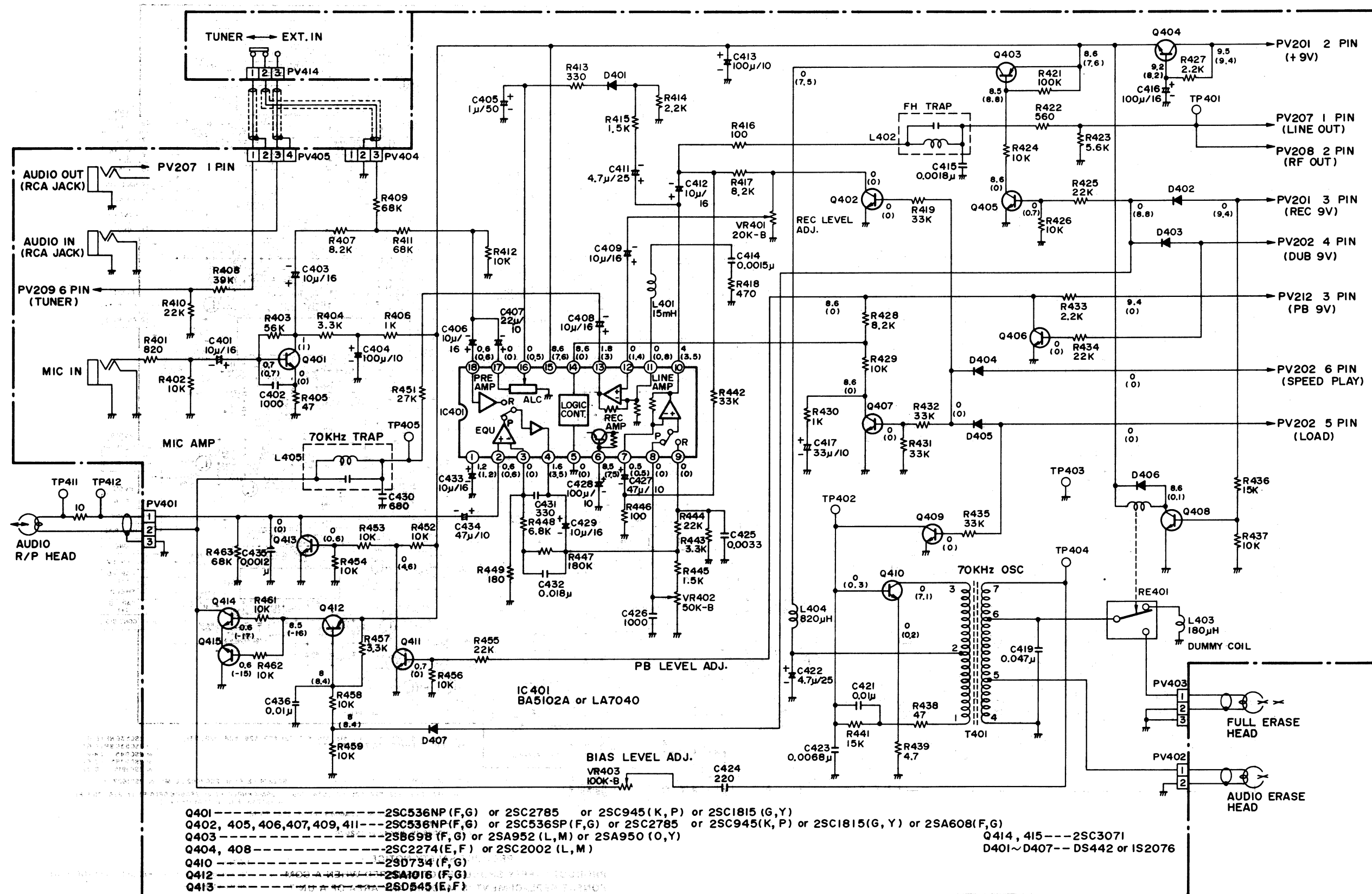
GSA30C

NOTES. B : Base C : Collector E : Emitter

VIDEO AUDIO P.C.B.



AUDIO CIRCUIT DIAGRAM



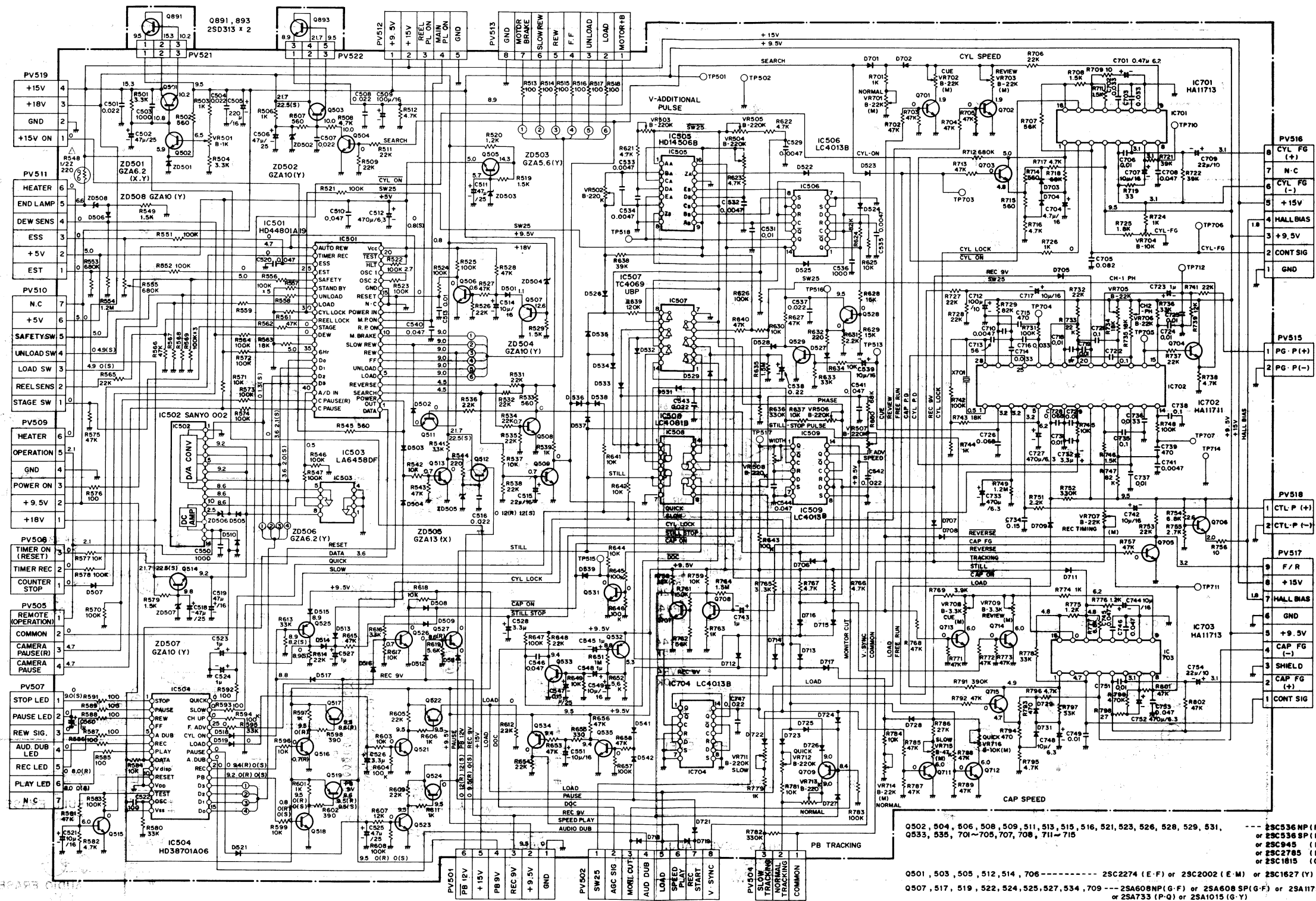
NOTES:

All voltage are in PLAY mode
 unless otherwise noted.
 () : RECORD mode

NOTES:

1. All resistance values in "OHMS" unless otherwise noted (K=1,000
 M=1,000,000)
 2. All inductance values in "mH" unless otherwise noted. μ =microhenry.

SYSTEM CONTROL SERVO DIAGRAM



PRODUCT SAFETY NOTICE

PRODUCT SAFETY SHOULD BE CONSIDERED WHEN A COMPONENT REPLACEMENT IS MADE IN ANY AREA OF A UNIT. COMPONENTS INDICATED BY THE SYMBOL Δ IN THIS SCHEMATIC DIAGRAM SHOW COMPONENTS WHOSE VALUE HAVE SPECIAL SIGNIFICANCE TO PRODUCT SAFETY. IT IS PARTICULARLY RECOMMENDED THAT ONLY PARTS SPECIFIED ON THE ATTACHED PARTS LIST BE USED FOR COMPONENT REPLACEMENT DESIGNATED BY THE SYMBOL.

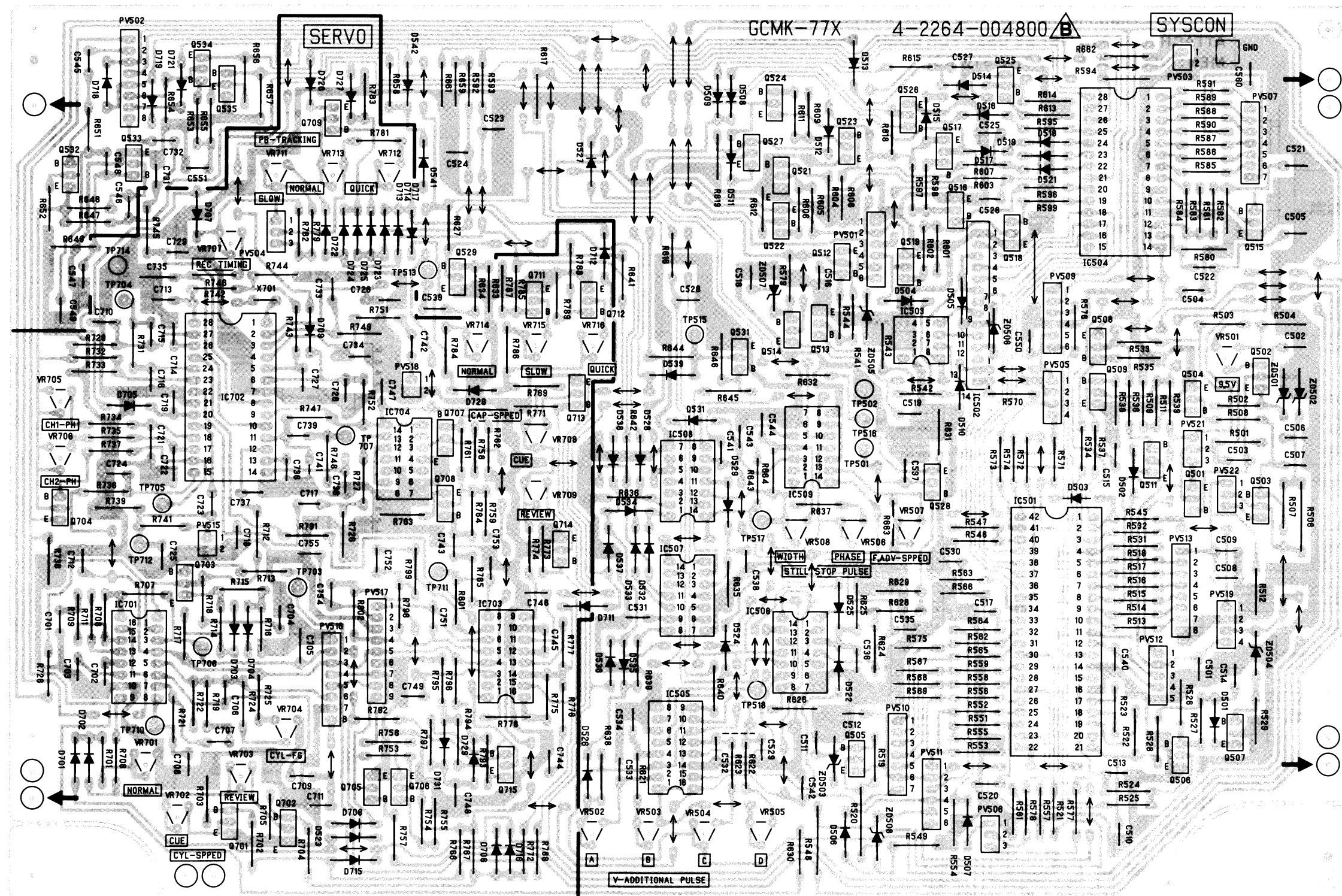
NOTES:

All voltage are in PLAY, RECORD and STOP mode unless otherwise noted.
(R) = RECORD mode only
(S) = STOP Mode only

NOTES:

1. All resistance values in "OHMS" unless otherwise noted. (K=1,000 M=1,000,000)
2. All inductance values in "mH" unless otherwise noted. μ =micro henry.

SYSTEM CONTROL SERVO P.C.B.



SYSTEM CONTROL DRIVE DIAGRAM

PRODUCT SAFETY NOTICE

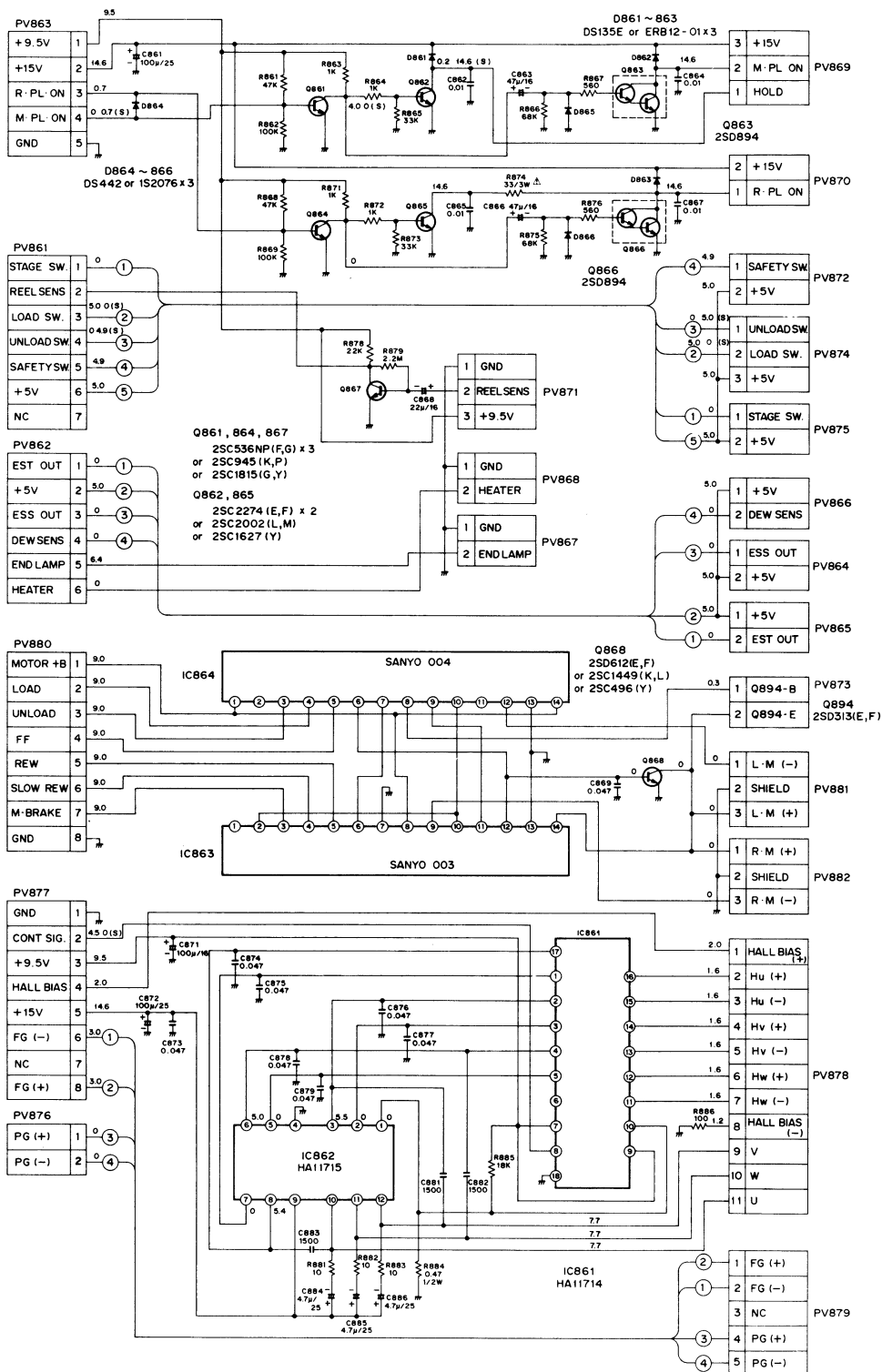
NOTES:

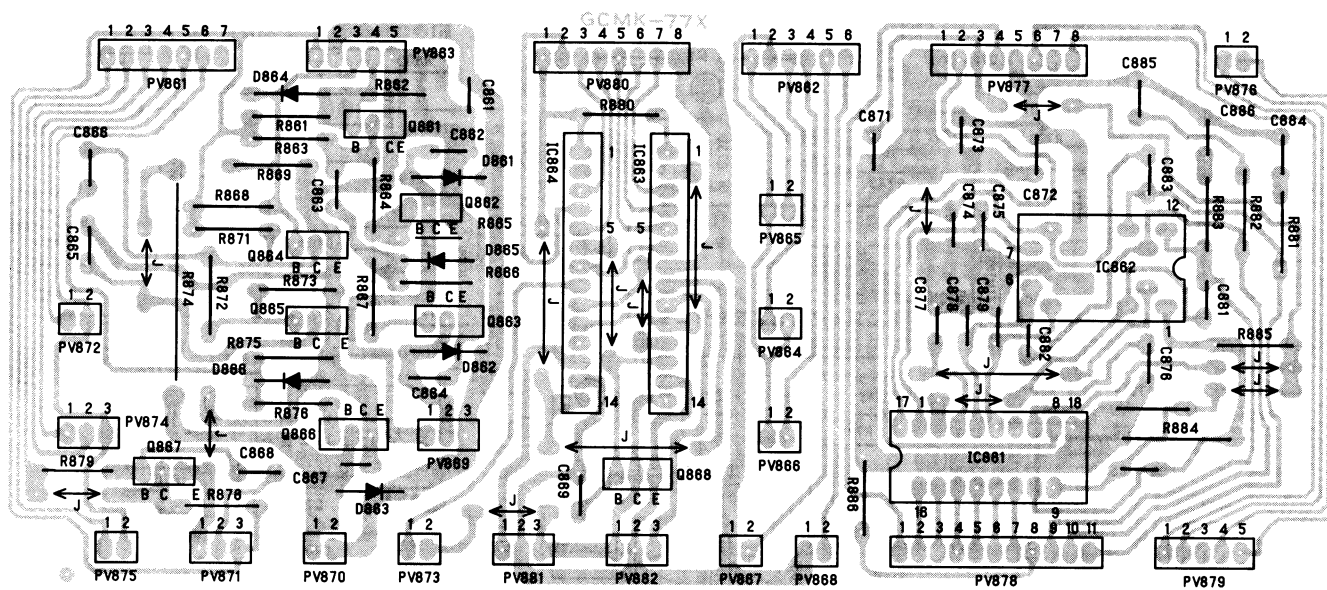
All voltage are in PLAY, RECORD and STOP mode unless otherwise noted.
(S) = STOP mode only

NOTES:

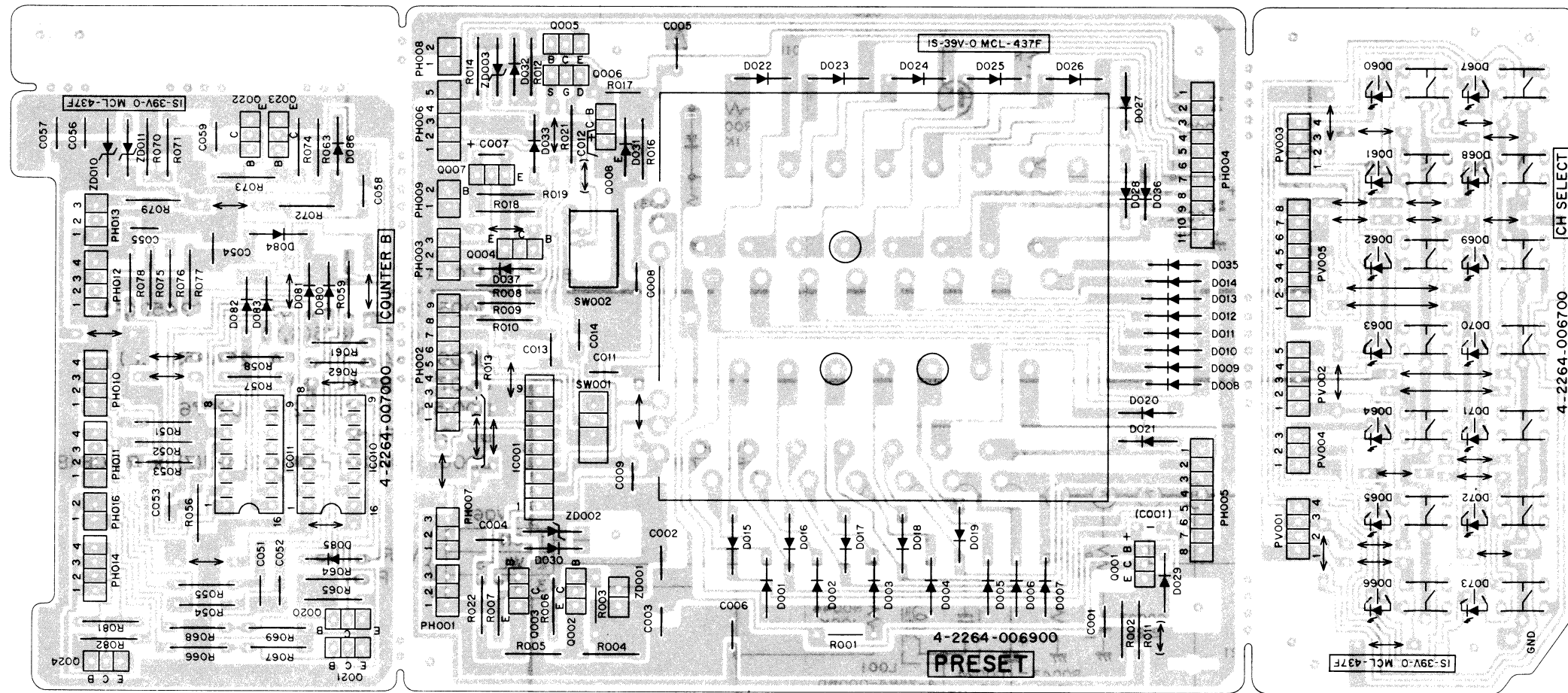
1. All resistance values in "OHMS" unless otherwise noted. (K=1,000 M=1,000,000)
2. All inductance values in "mH" unless otherwise noted. μ =micro henry.

PRODUCT SAFETY SHOULD BE CONSIDERED WHEN A COMPONENT REPLACEMENT IS MADE IN ANY AREA OF A UNIT. COMPONENTS INDICATED BY THE SYMBOL Δ IN THIS SCHEMATIC DIAGRAM SHOW COMPONENTS WHOSE VALUE HAVE SPECIAL SIGNIFICANCE TO PRODUCT SAFETY. IT IS PARTICULARLY RECOMMENDED THAT ONLY PARTS SPECIFIED ON THE ATTACHED PARTS LIST BE USED FOR COMPONENT REPLACEMENT DESIGNATED BY THE SYMBOL.

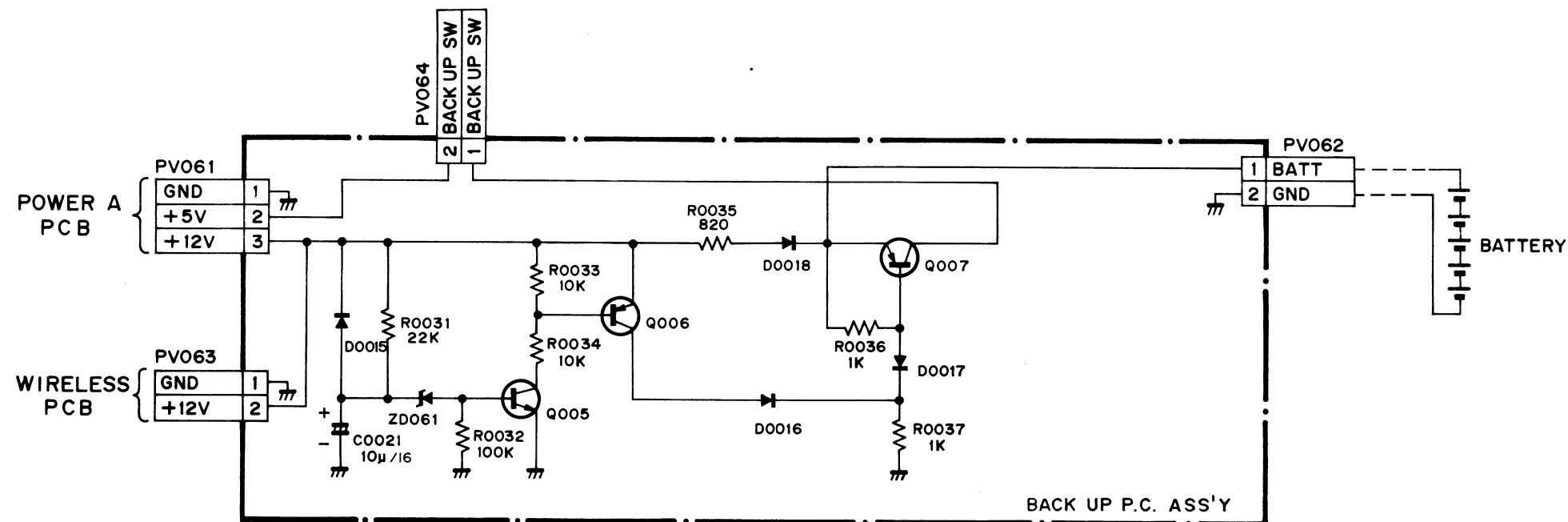




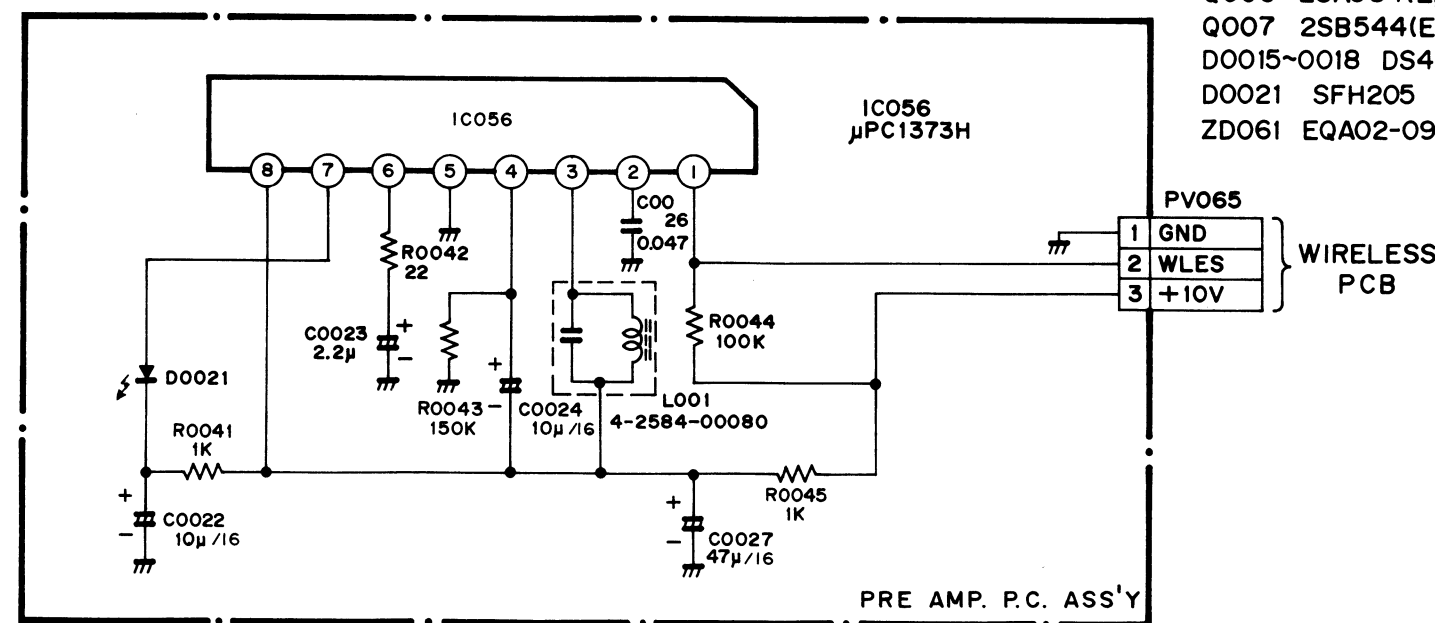
CHANNEL SELECT PRESET AND COUNTER P.C.B.

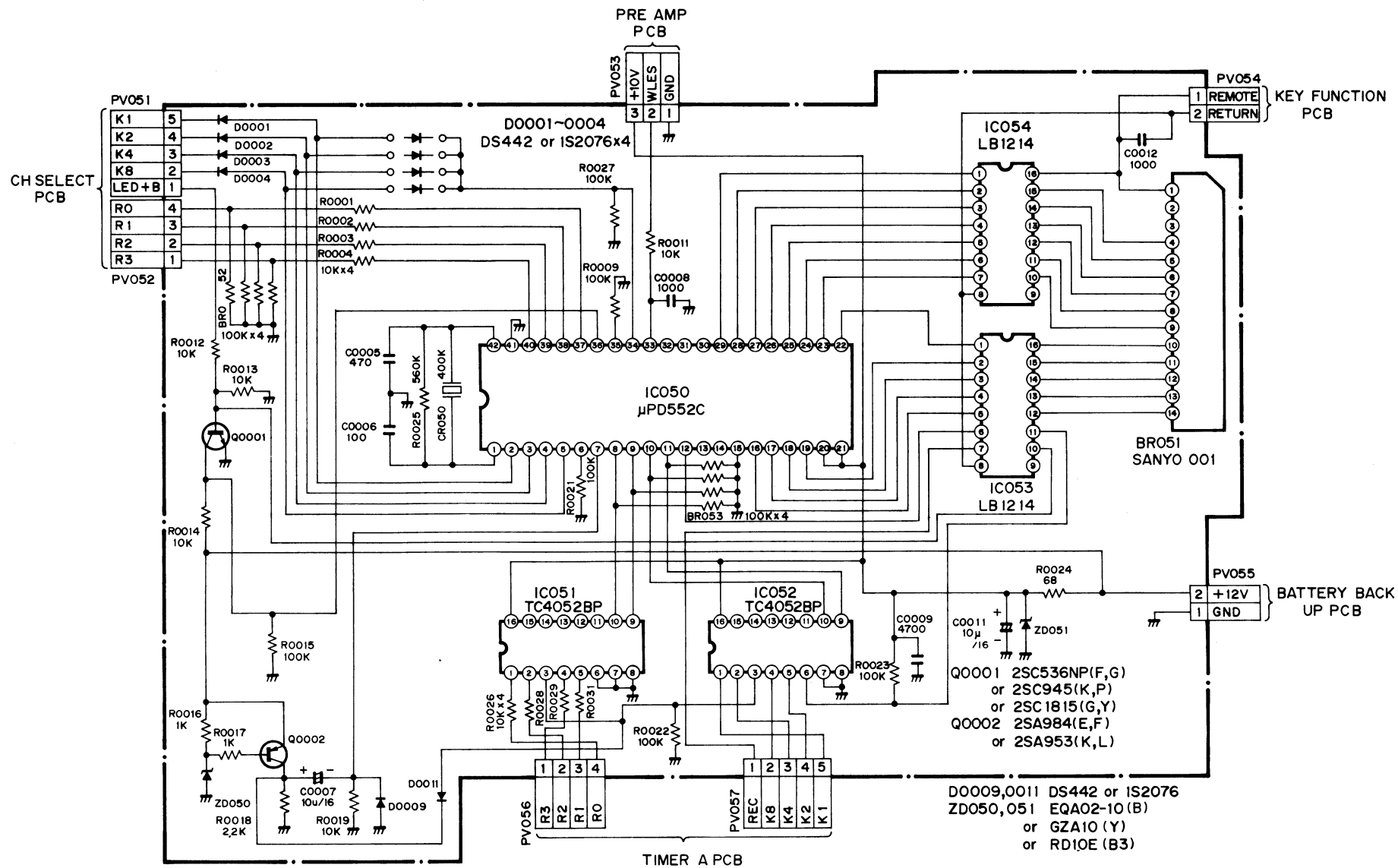


BACK UP AND PRE AMP DIAGRAM



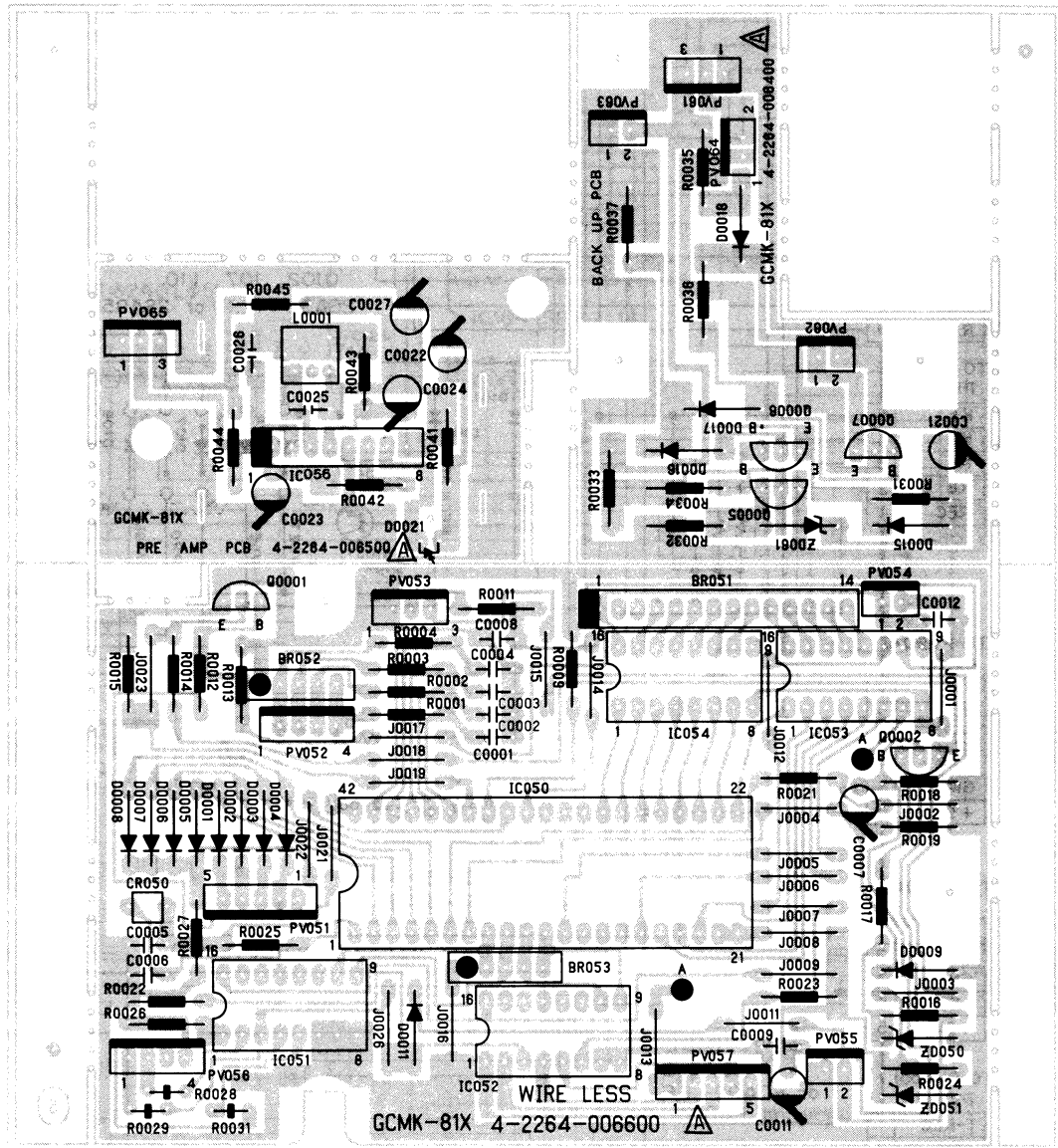
- Q005 2SC536NP(F,G) or 2SC945(K,P) or 2SC1815(G,Y)
- Q006 2SA984(E,F) or 2SA953(K,L)
- Q007 2SB544(E,F)
- D0015~0018 DS442 or 1S2076
- D0021 SFH205
- ZD061 EQA02-09(D) or GZA9.1(Z) or RD10E (B1)



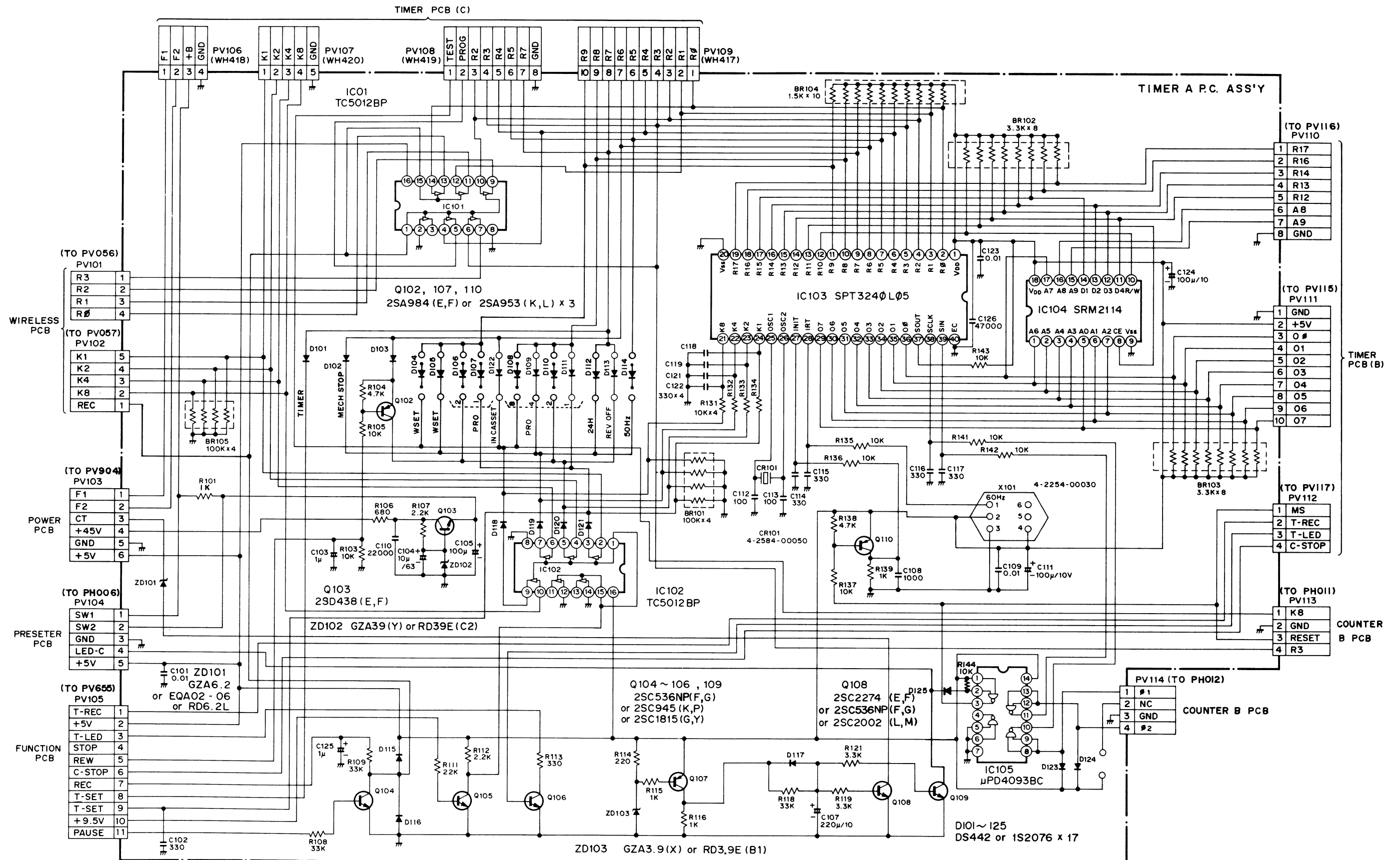


WIRELESS DIAGRAM

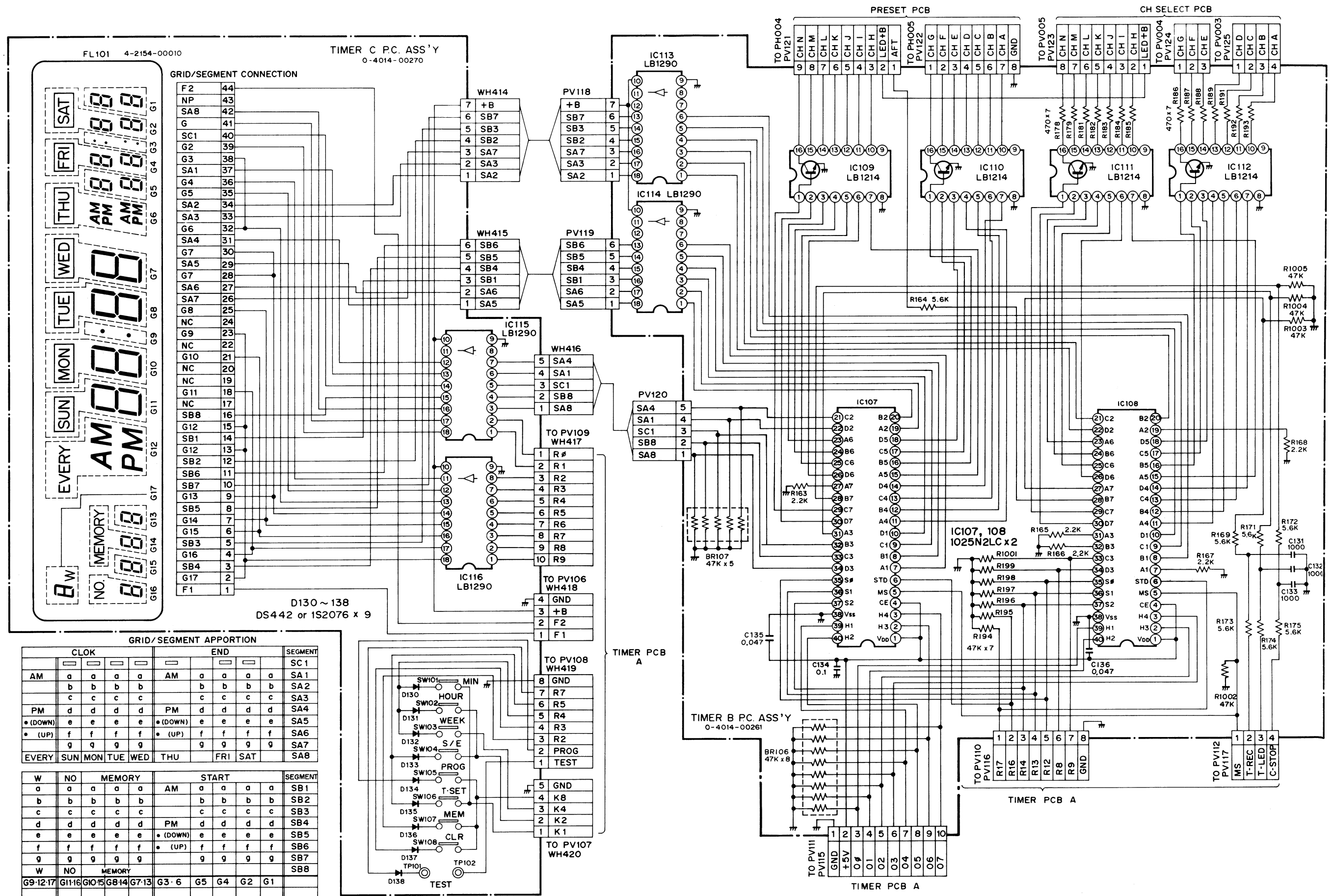
BACK UP AND PRE AMP AND WIRELESS P.C.B.



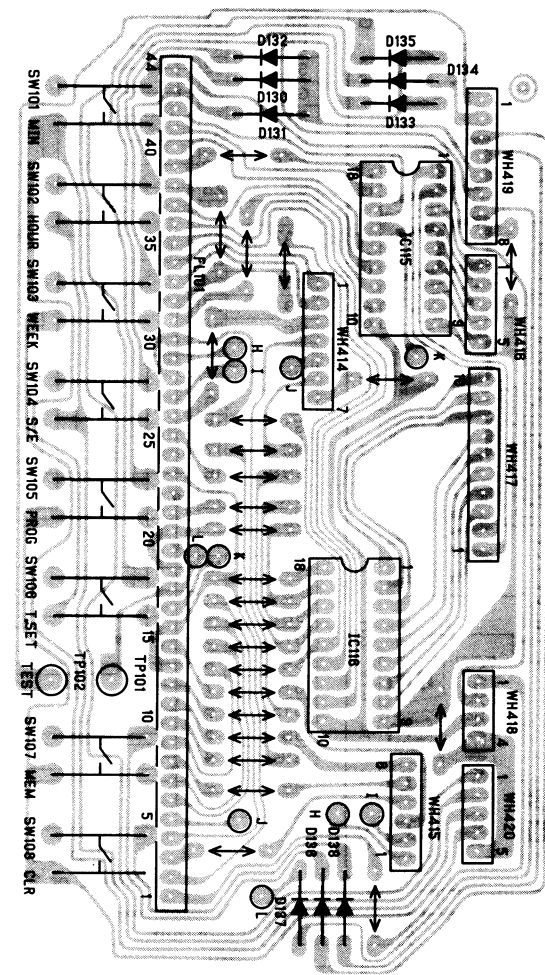
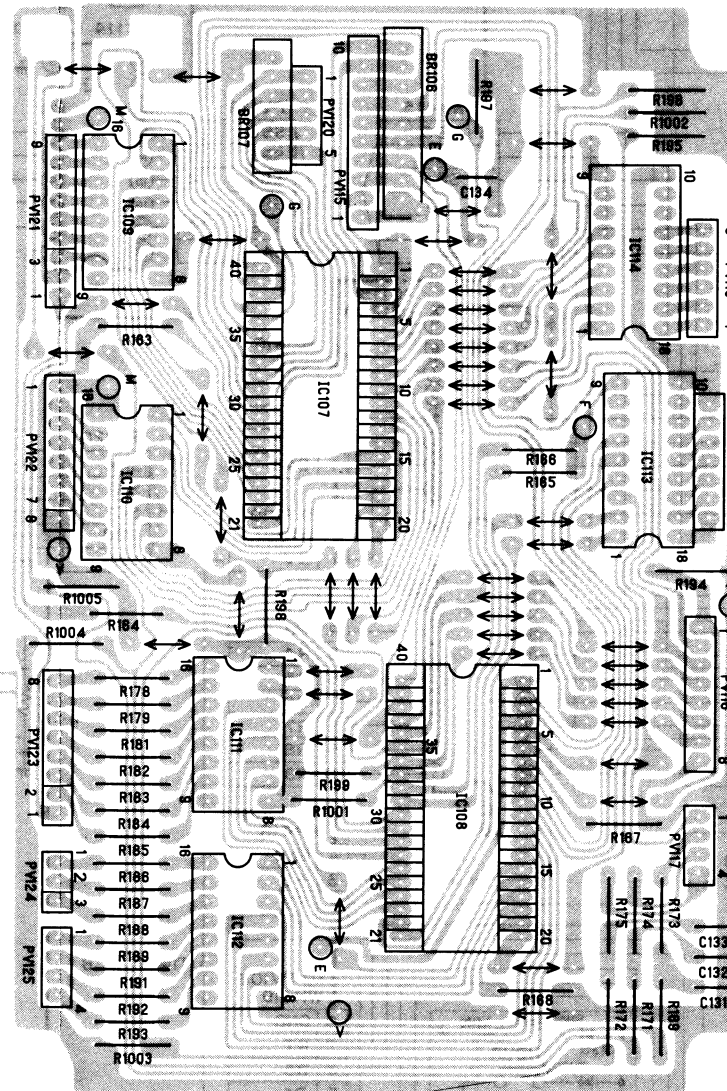
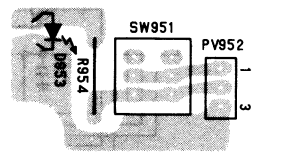
TIMER A DIAGRAM



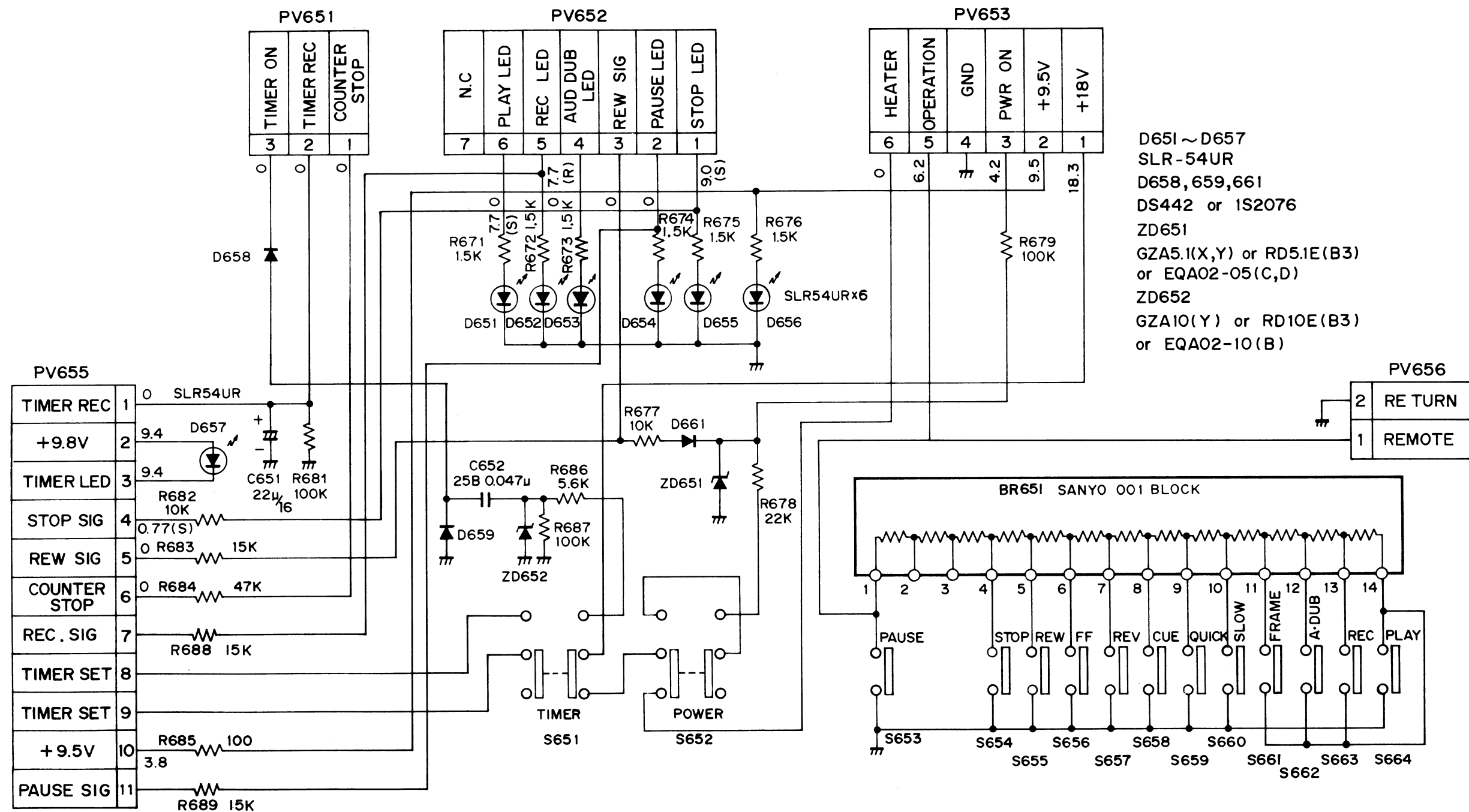
TIMER B.C. DIAGRAM



TIMER A.B.C. P.C.B.

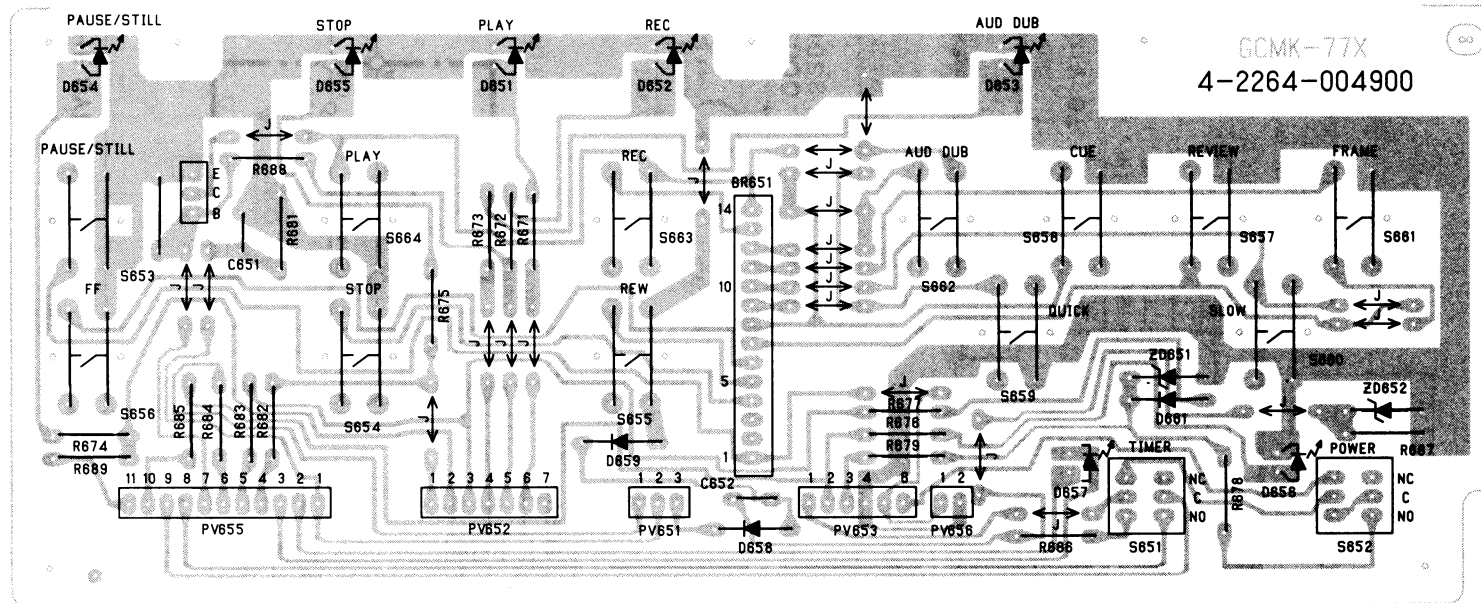


KEY FUNCTION DIAGRAM



- NOTES:
- All voltage are in PLAY, RECORD and STOP mode unless otherwise noted.
- (R)=RECORD mode only
- (S)=STOP mode only
- NOTES:
1. All resistance values in "OHMS" unless otherwise noted. (K=1,000 M=1,000,000)
2. All inductance values in "mH" unless otherwise noted. μ =micro henry.

KEY FUNCTION P.C.B.



—PRODUCT SAFETY NOTICE

GRAM SHOW COMPONENTS WHOSE VALUE HAVE
GNIFICANCE TO PRODUCT SAFETY. IT IS PARTICULARLY
COMMENDED THAT ONLY PARTS SPECIFIED ON THE
PARTS LIST BE USED FOR COMPONENT REPLACEMENT
IGNATED BY THE SYMBOL.

AC220V
50Hz

POWER SWITCH

FUSE F901
T500mA-250V

AC1 AC2 AC3 AC4

C901
0.047 μ

THERMAL FUSE
130°C

4-2514-00120

PV905

FUSE F902
T3.15A-250V

D901~D904
GSA30C x 4

C904 4700 C902 4700

C905 4700 C903 4700

D905
ERB12-02
or DS135D

C912
470

FUSE F903
T100mA-250V

37.8

FUSE F904
T160mA-250V

5.85

FUSE F905
T160mA-250V

5.85

PV906

Q902 2SC2274(E,F)
or 2SC2002(L,M)

20.4

C908 0.01 μ 16.4 0(S)

R902 3.9K R903 220

Q903

16.5 0(S)

R905 47K R904 10K

C910 100 μ /25

C911 47 μ /10

PV902

4 15V REG

3 18V

2 GND

1 15V CONT

TO S/S

PV903

3 12V

2 GND

1 45V

TO PRESET

PV904

1 AC 4.3V

2 AC 4.3V

3 COMMON

4 45V

5 GND

6 5V

TO TIMER

Q903, 905, 906
2SC536NP(F,G)
or 2SC945 (K,P)
or 2SC1815(G,Y)

ZD902
EQA02-06(C,D)
or GZA6.2(X,Y)
or RD6.2E(B2,B3)

Q904 2SC2274(E,F)
or 2SC2002(L,M)

20.4

D911
DS442 or IS2076

R906 10K C919 0.01

Q904

12.5

R907 560 R908 2.2K

VR901
B-1K
12V ADJ.

C918 47 μ /25

Q905

6.6

6.0

ZD902

R909 3.3K

TP901

Q907 2SB698(F,G)

11.0 11.3(S)

R911 47K R913 3.3K

0 11.3(S)

11.7 0(S)

C920 0.022 μ C921 100 μ /25

PV907

1 12.5

2 11.8

3

Q009 2SD613(E)

R931 47

PV909

1 12V

2 GND

3 GND

TO RF BOOSTER

PV910

1 POWER ON12V

2 GND

TO VIDEO

PV911

1 GND

2 5V

3 12V

TO TIMER BACK UP

PV912

1 GND

2 GND

3 12V

TO MUTE

FUSE RESISTOR

R910 15

9.5

TR901
L78M05

5.7

C922 33 μ /16 C923 0.022 C924 0.022 C925 33 μ /16

D910
DS442
or IS2076

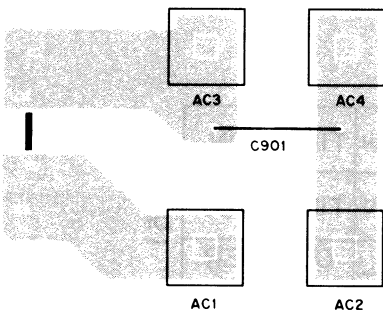
D908
ERA81-004
or EK04

D909 ERA81-004
or EK04

NOTES:

1. All resistance values in "OHMS" unless otherwise noted. (K=1,000
M=1,000,000)
2. All inductance values in "mH" unless otherwise noted. μ =micro henry.

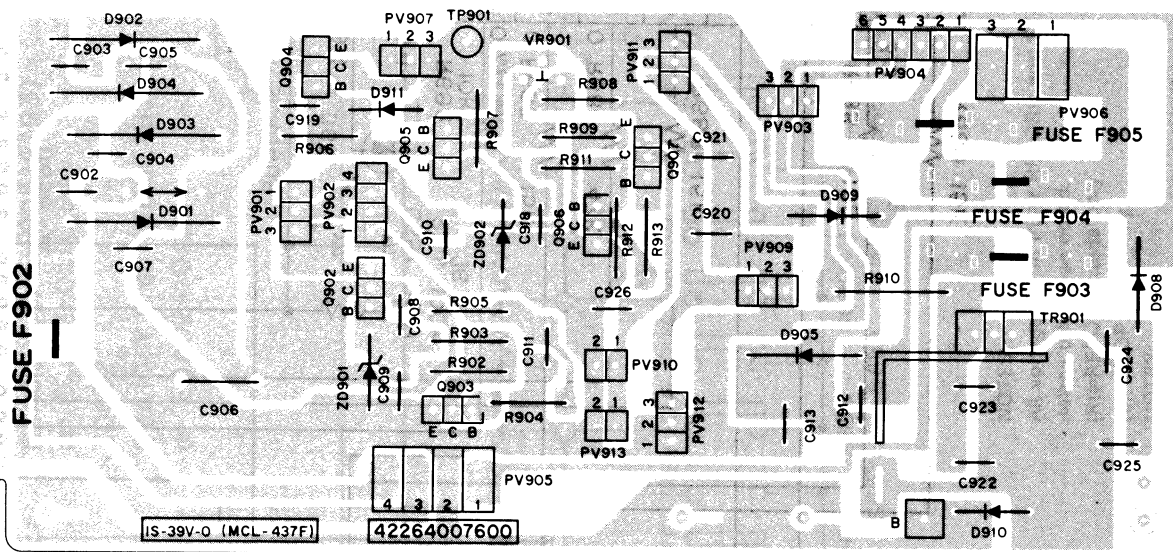
FUSE F901



IS-39V-O (MCL-437F)

42264007700

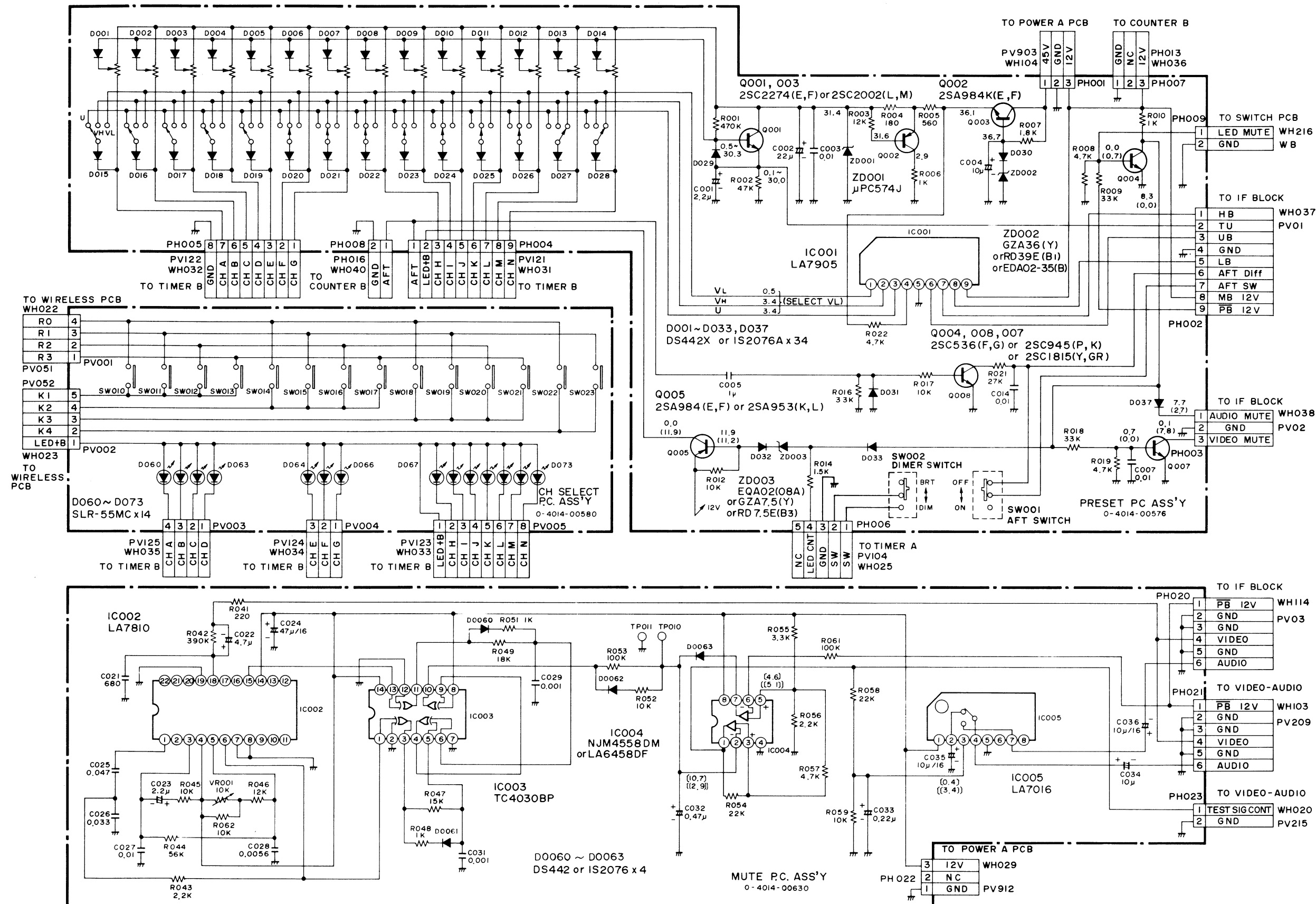
FUSE F902



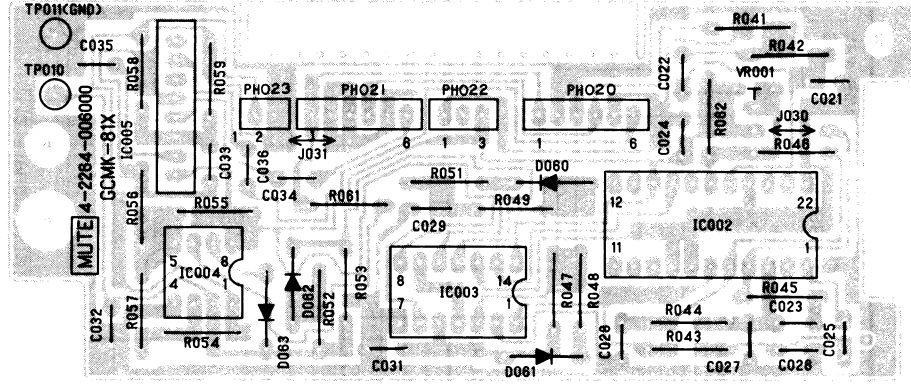
IS-39V-O (MCL-437F)

42264007600

PRESET MUTE DIAGRAM



MUTE P.C.B.



P.C.B. VD-1 VIDEO (1)/VIDEO PRE/AUDIO

VR1506 FREQUENCY CHARACTERISTICS OF PRE-AMP
VR1503 FREQUENCY CHARACTERISTICS OF PRE-AMP
VR1501 DROPOUT COMPENSATOR SENSITIVITY

4-226V-01800C
JCI-AUH

VR1505 RECORDING AMP FREQUENCY CHARACTERISTICS
VR1504 RECORDING CURRENT
VR1006 VR1007
CARRIER FREQUENCY SETTING

VR1009 WHITE CLIP
VR1008 DARK CLIP

VR1010 COMPRESSOR VR1004 DEVIATION

VR1011 PLAYBACK LEVEL

VR1005 E-E LEVEL

VR1003 TEST SIGNAL OSCILLATION

VR2001 PLAYBACK EQUALIZER
VR2003 BIAS CURRENT

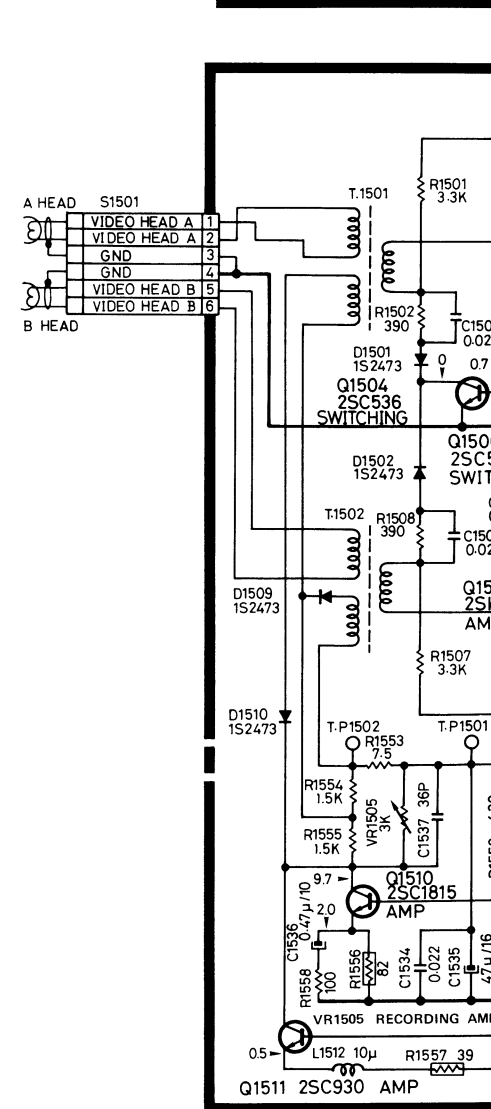
VR02 RECORDING CURRENT
VR01 EQ
VR03 BIAS
VR04

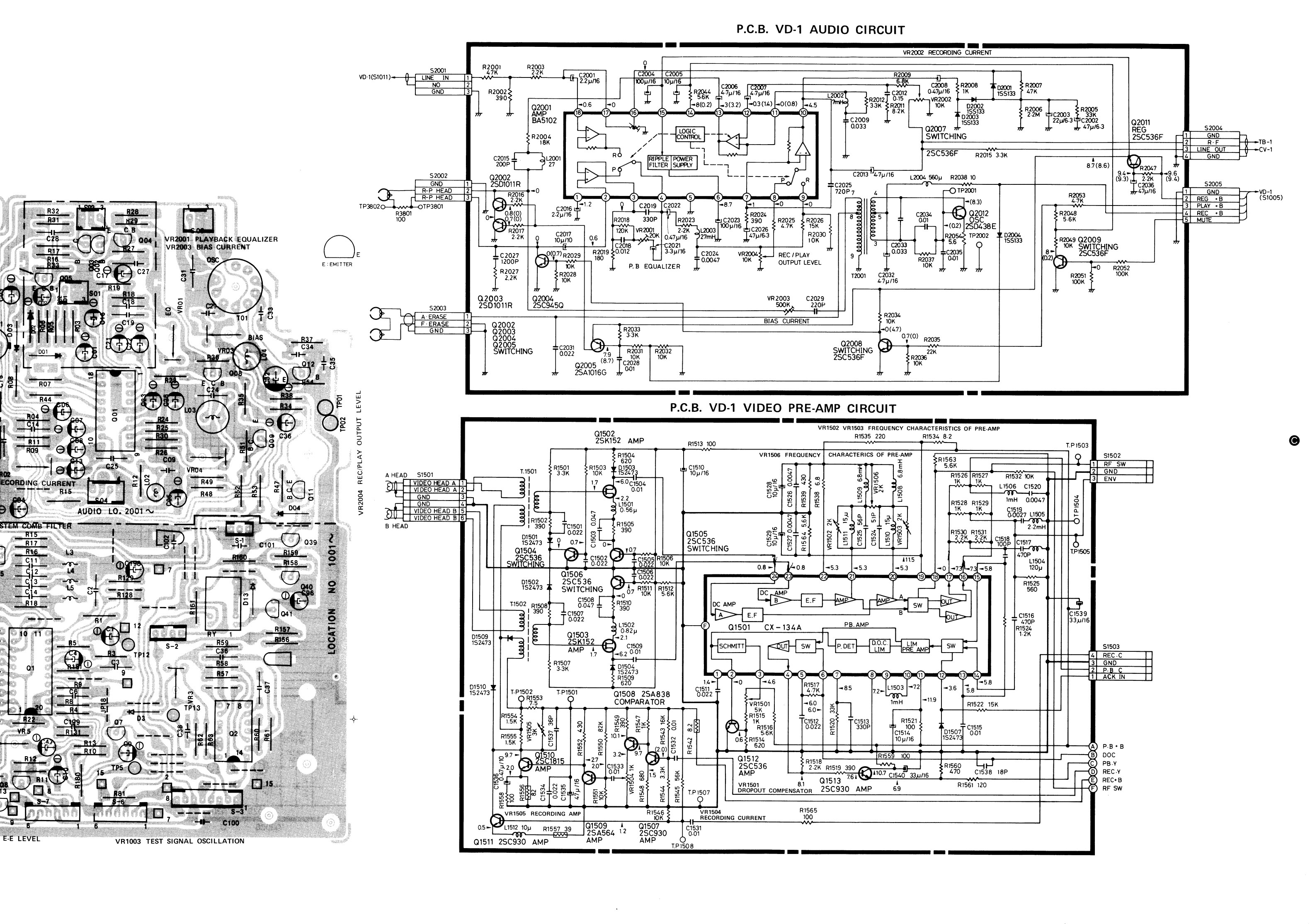
VR1001 IV SYSTEM COMB FILTER

VR1002 EXPANDER

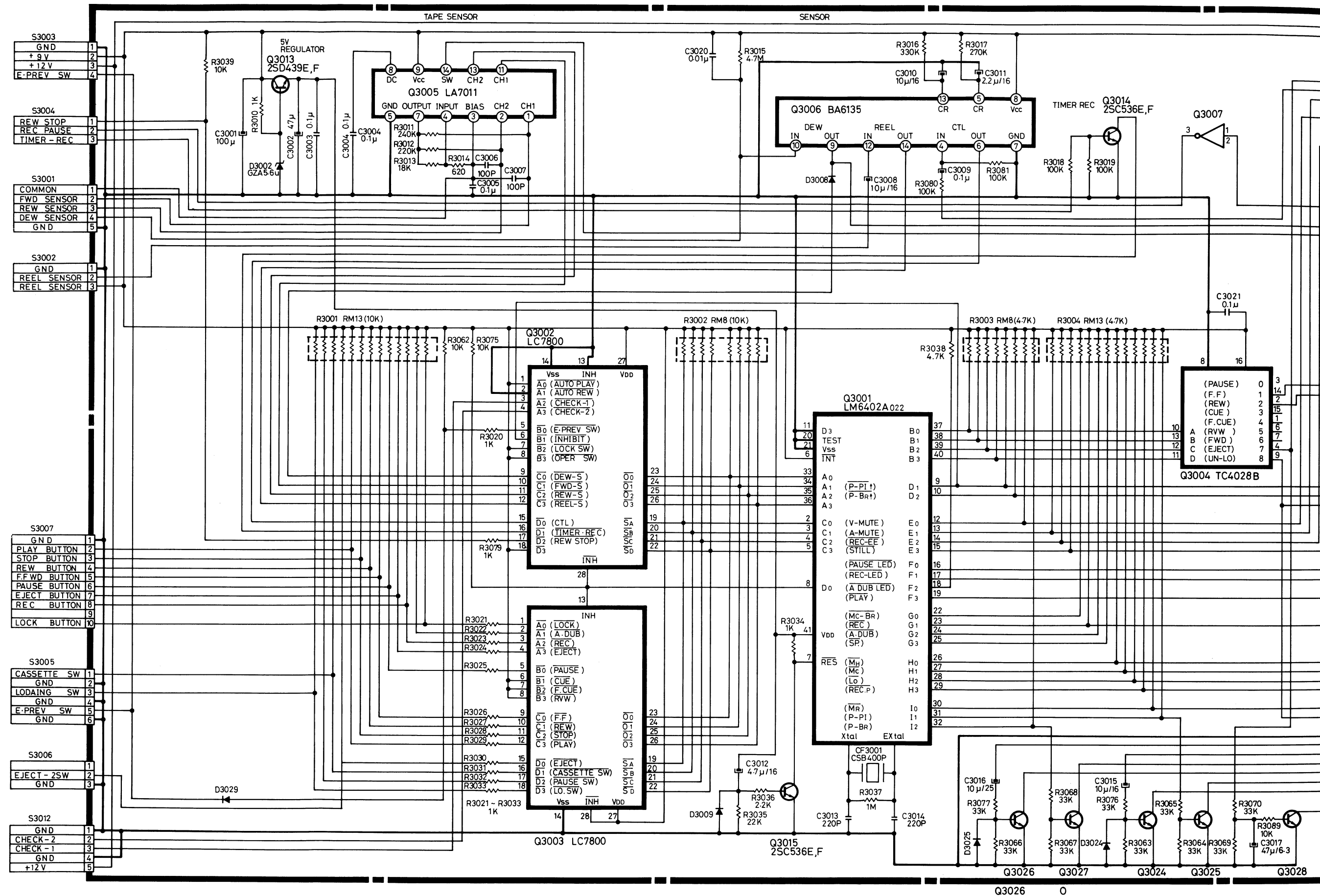
VR1000 LOCATION NO 1001~

VR1000 LOCATION NO 1001~

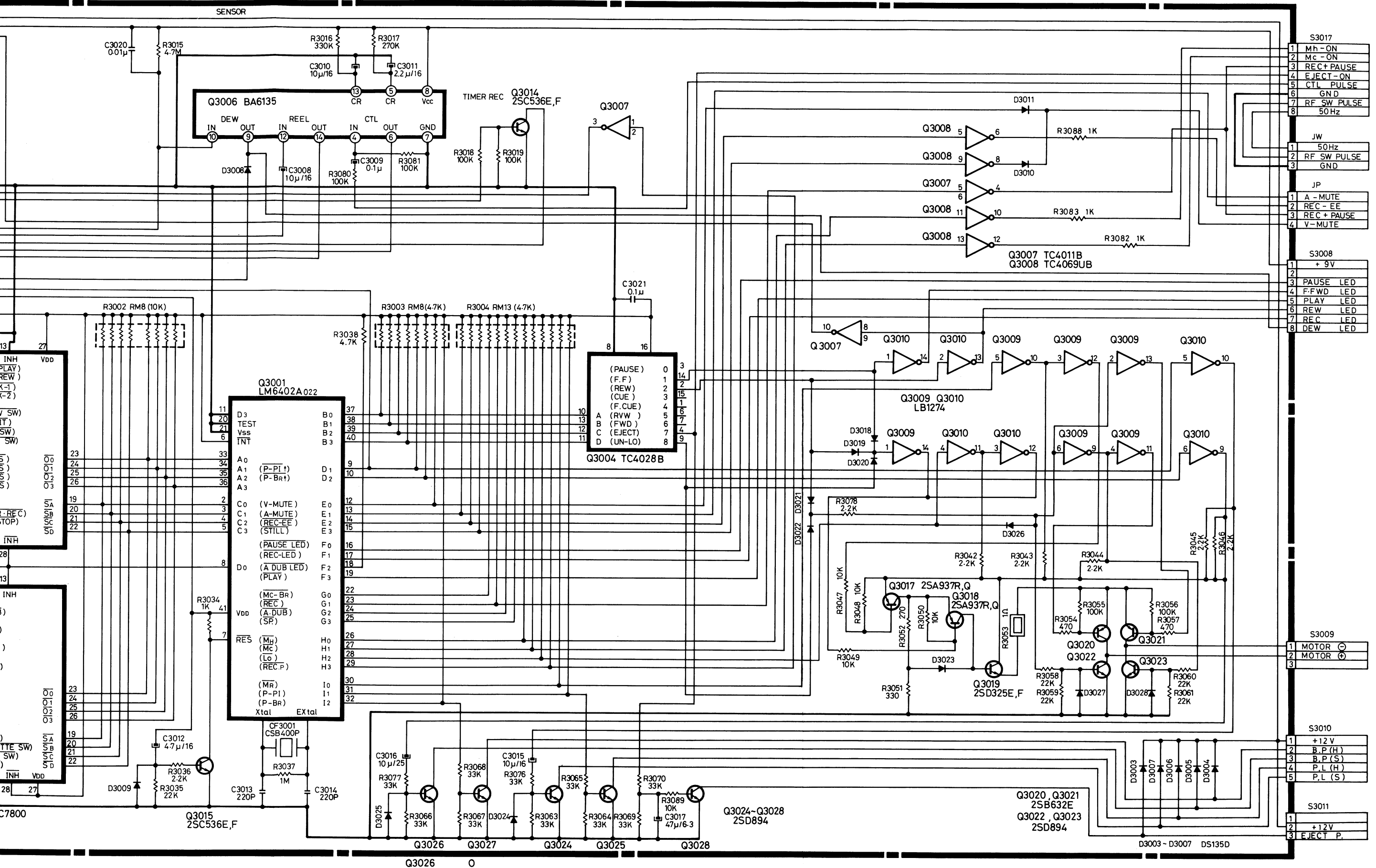


[illegible]

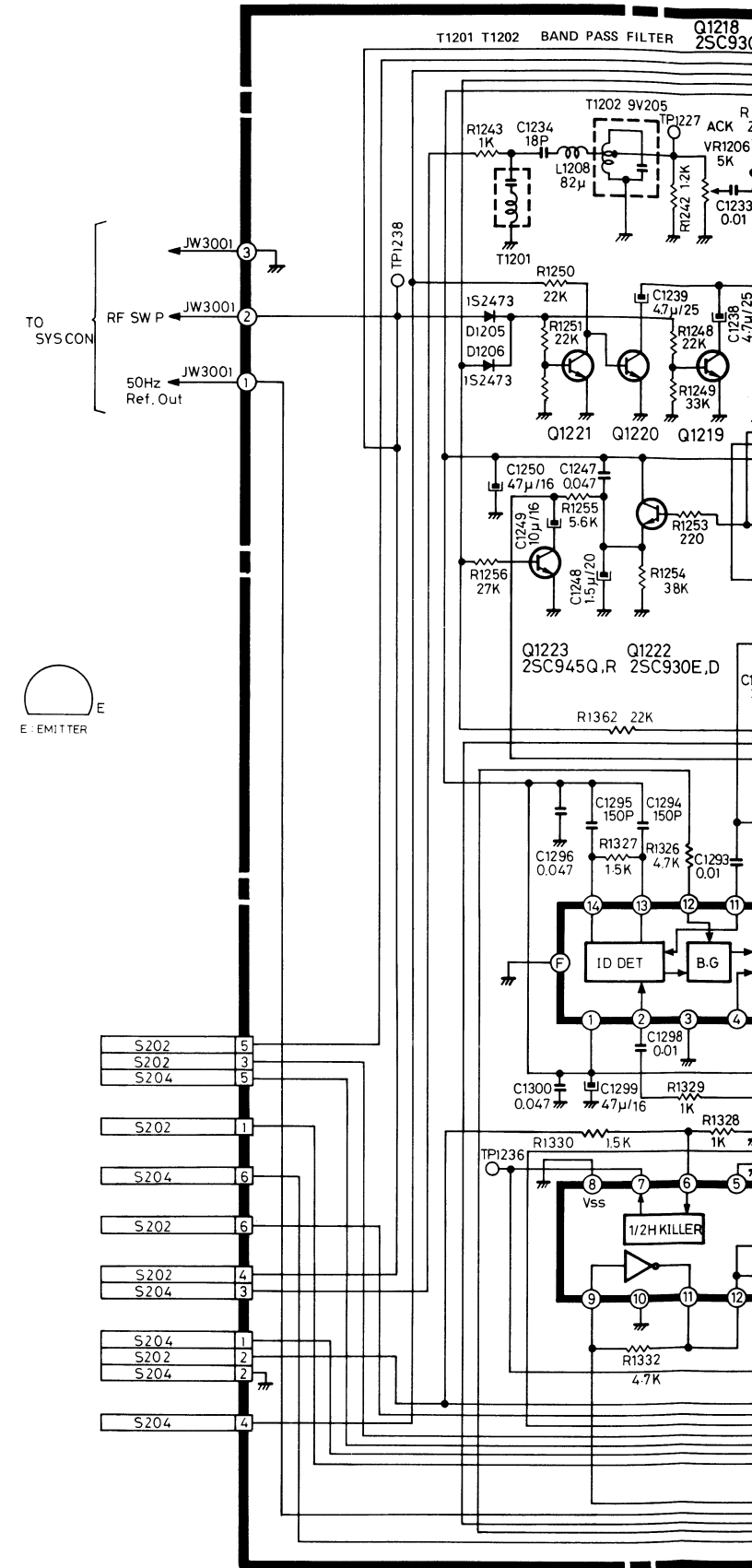
P.C.B. VD-2 SYSTEM CONTROL CIRCUIT



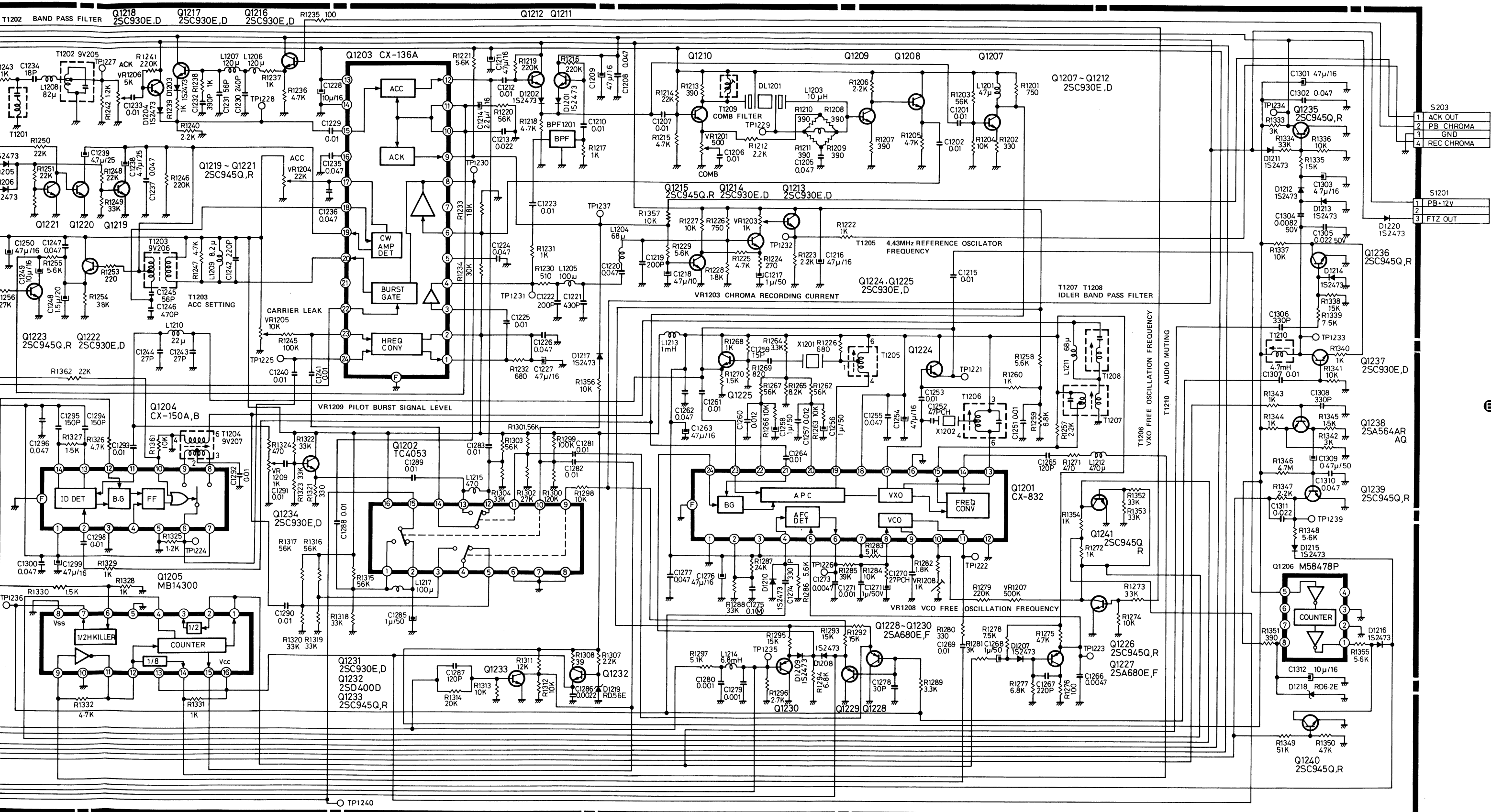
P.C.B. VD-2 SYSTEM CONTROL CIRCUIT



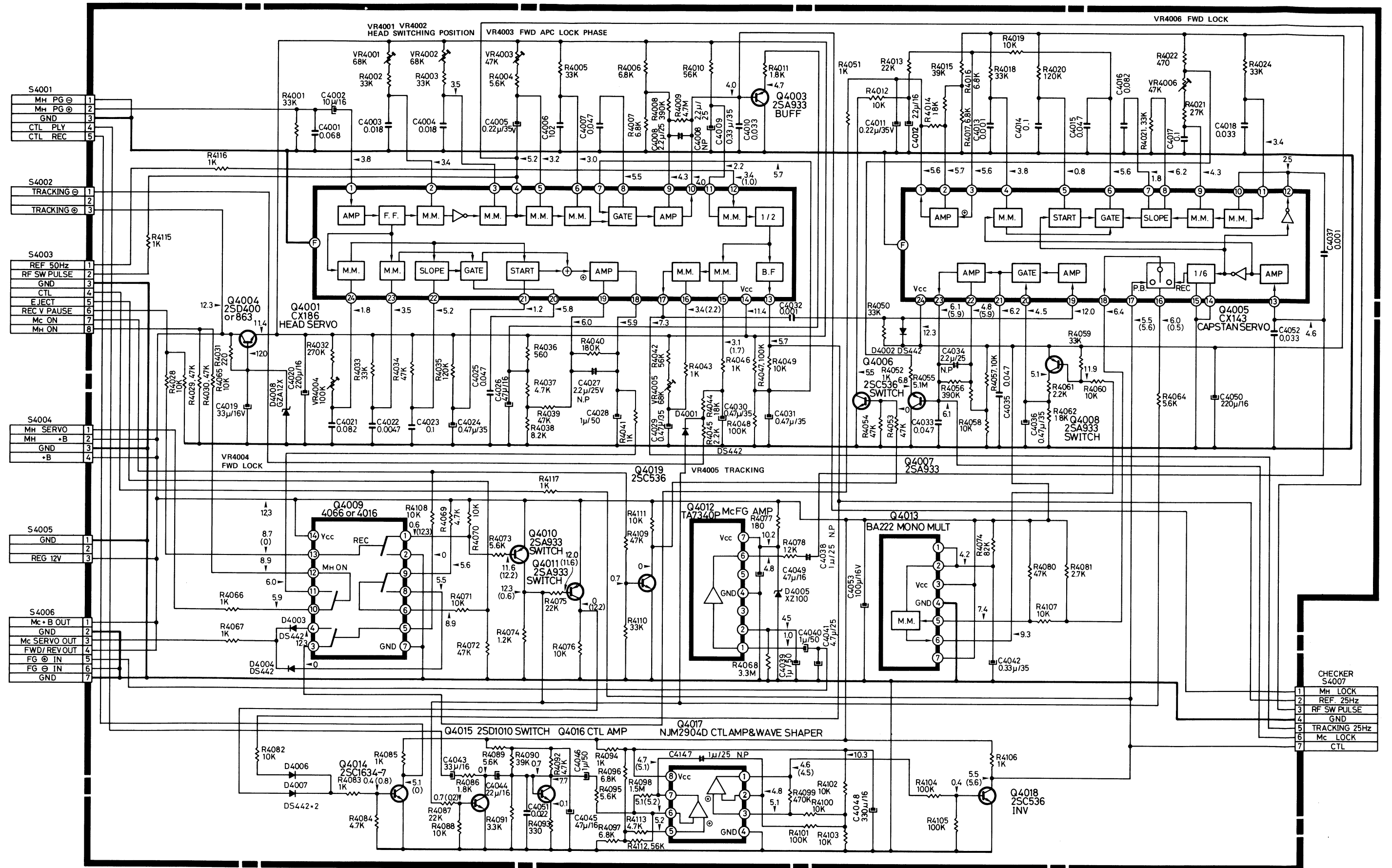
(VIDEO)



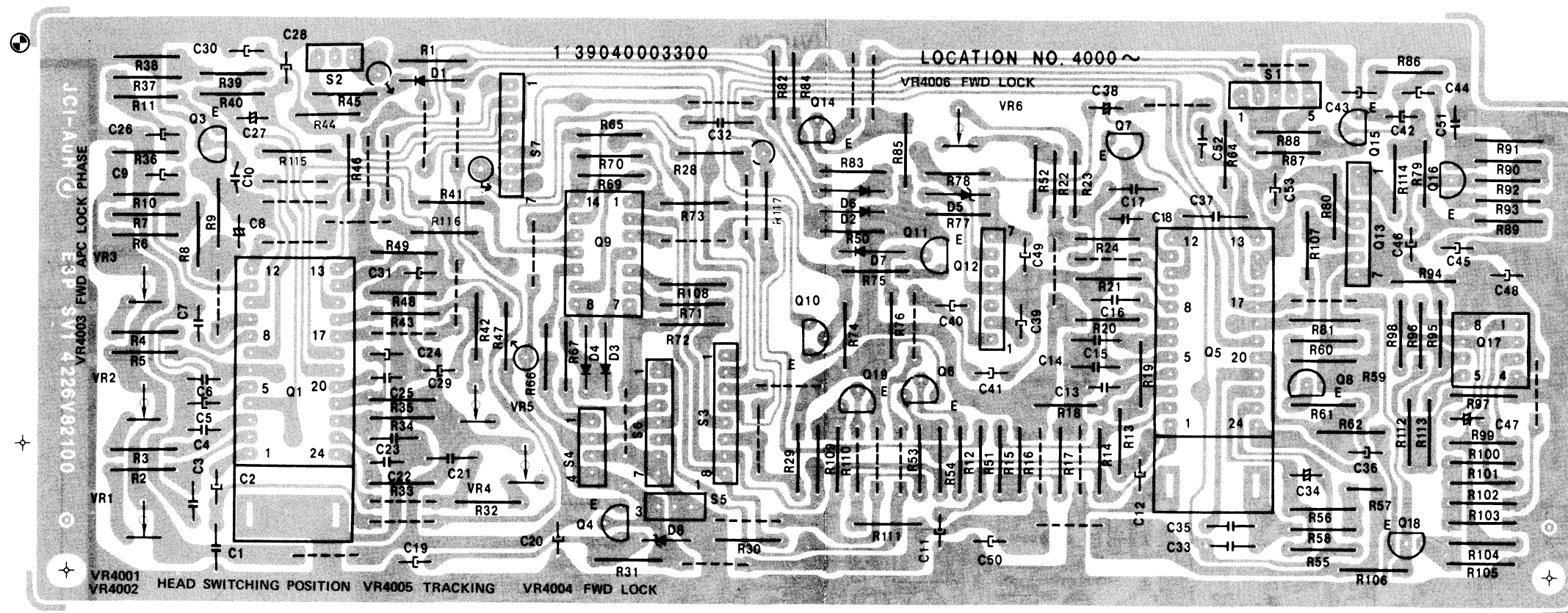
P.C.B. VD-2 VIDEO (2) CIRCUIT



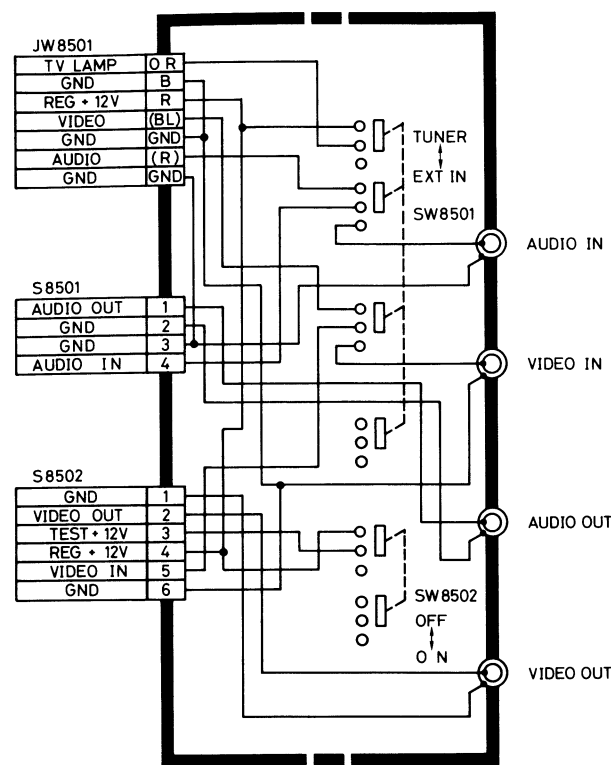
P.C.B. SV-1 SERVO CIRCUIT



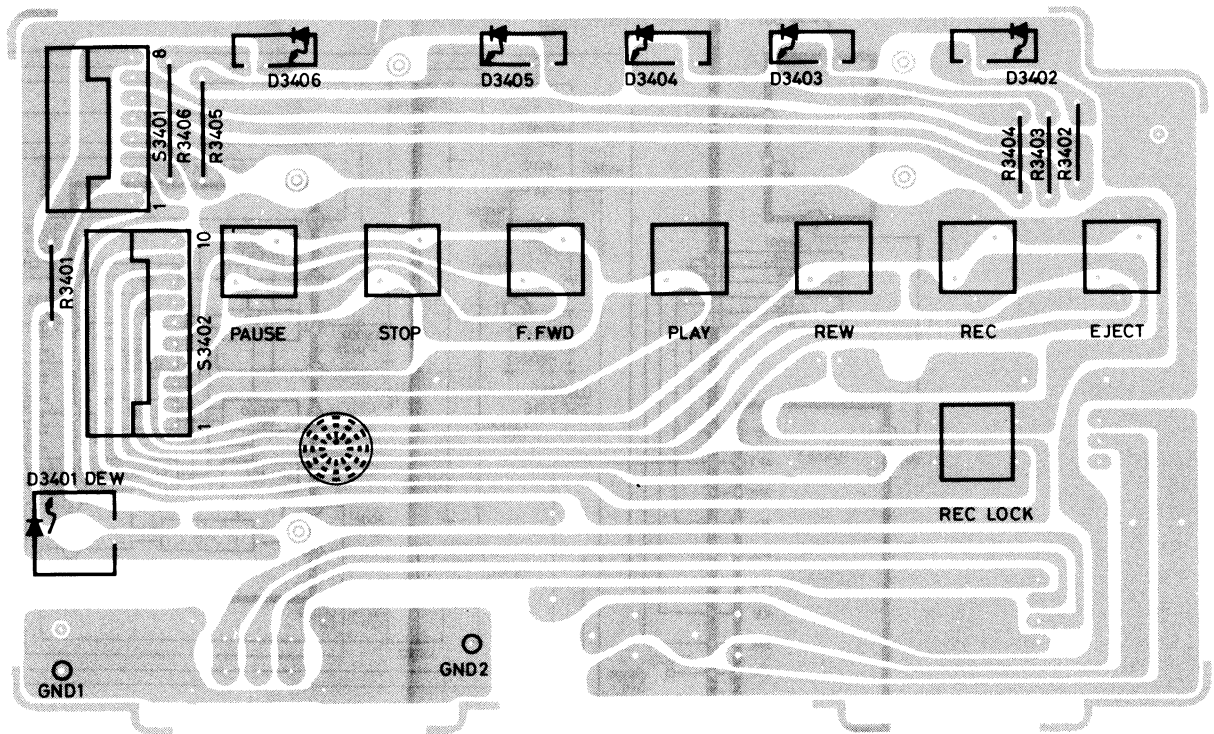
P.C.B. SV-1 SERVO



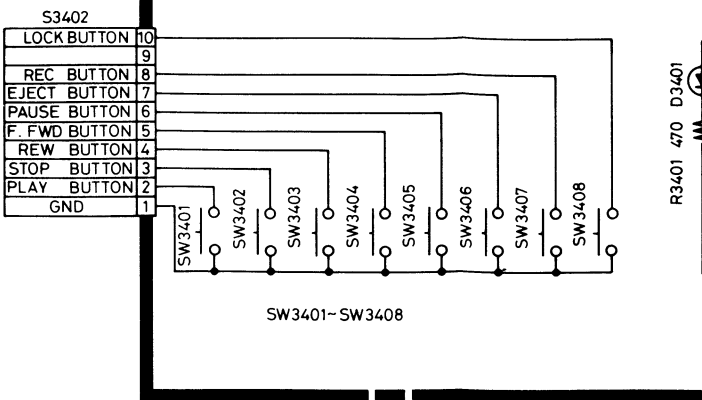
P.C.B. TB-1 TERMINAL CIRCUIT



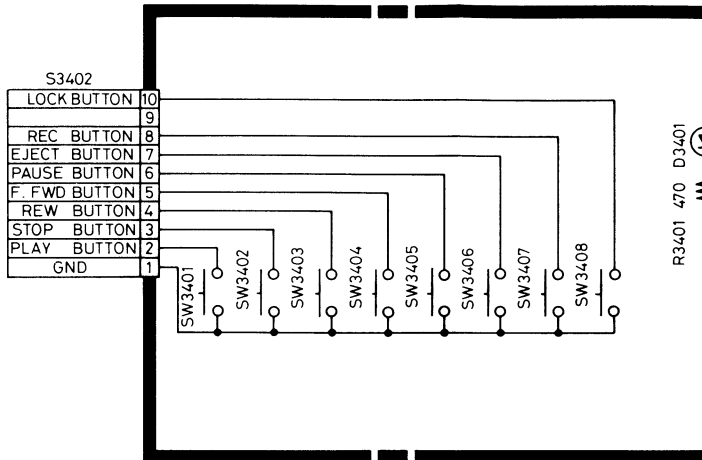
P.C.B. SY-2 OPERATION SWITCH



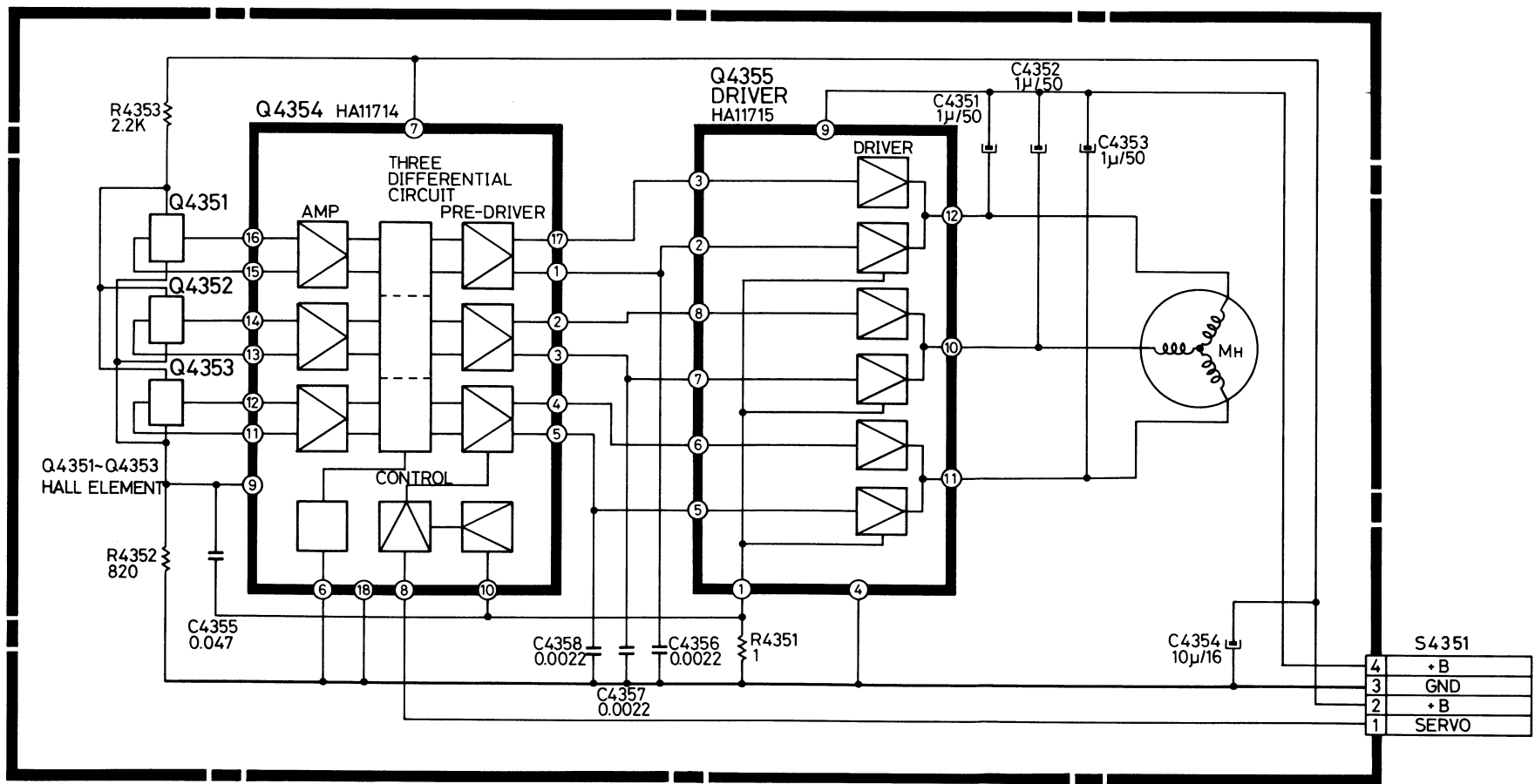
P.C.B. SY-2 OPERATION SWITCH



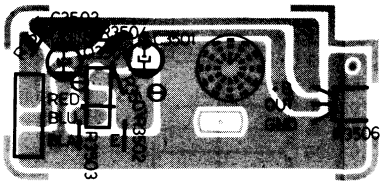
P.C.B. SY-2 OPERATION SWITCH



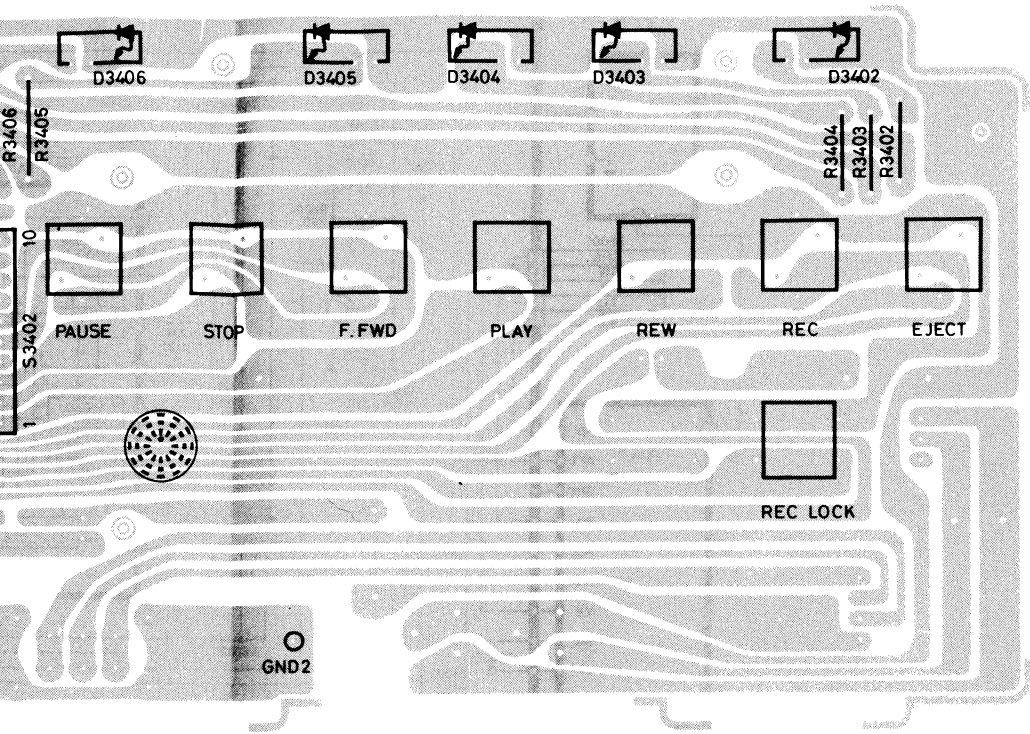
P.C.B. SV-3 HEAD MOTOR CIRCUIT



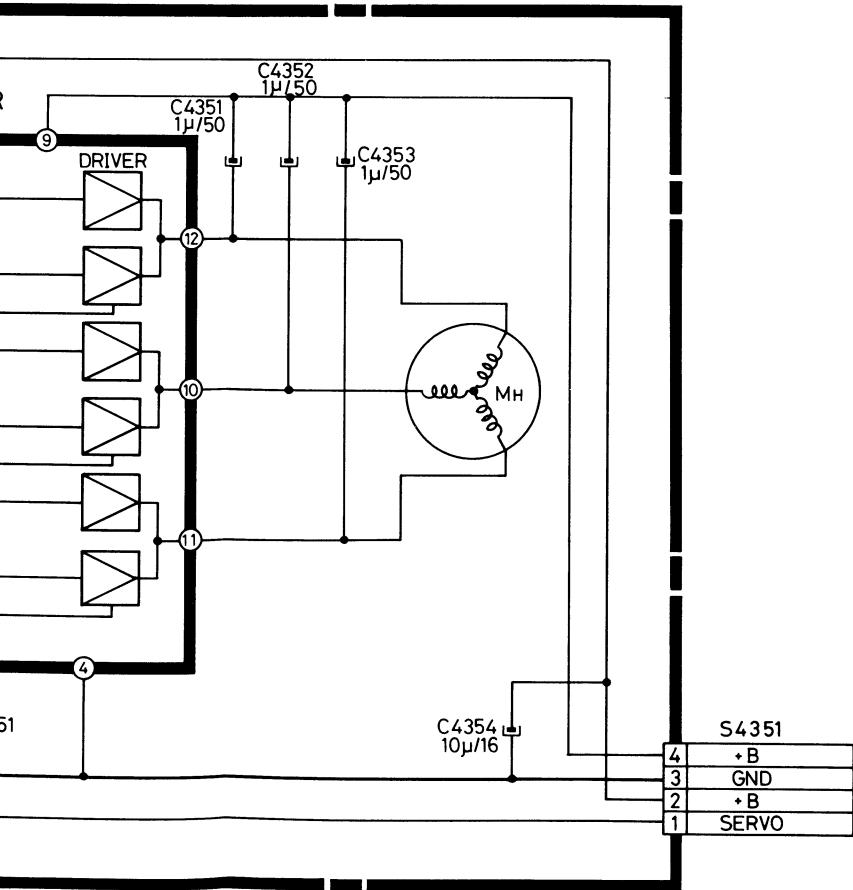
P.C.B. MC-1 REEL SENSOR



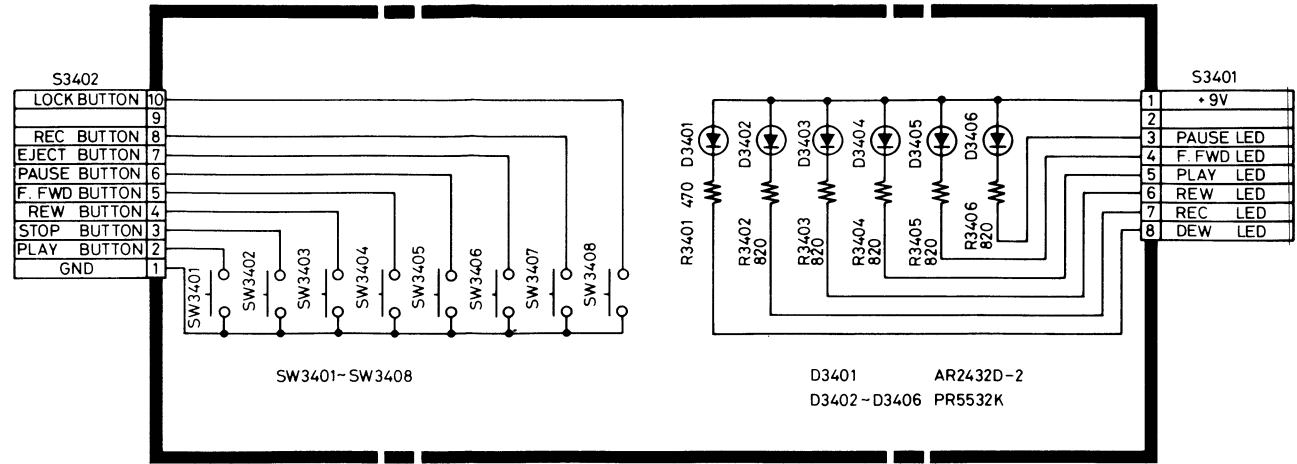
P.C.B. SY-2 OPERATION SWITCH



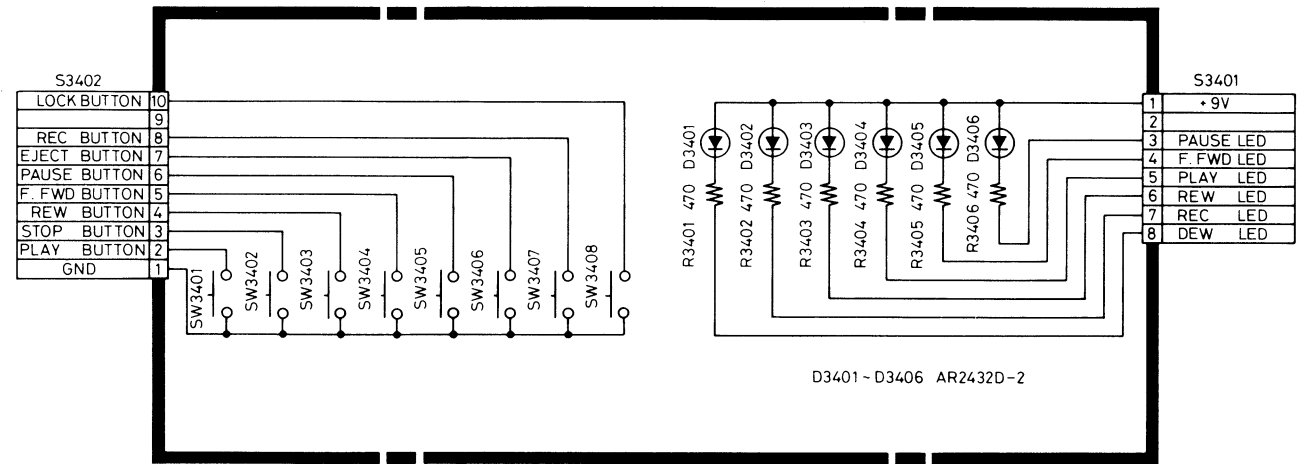
OR CIRCUIT



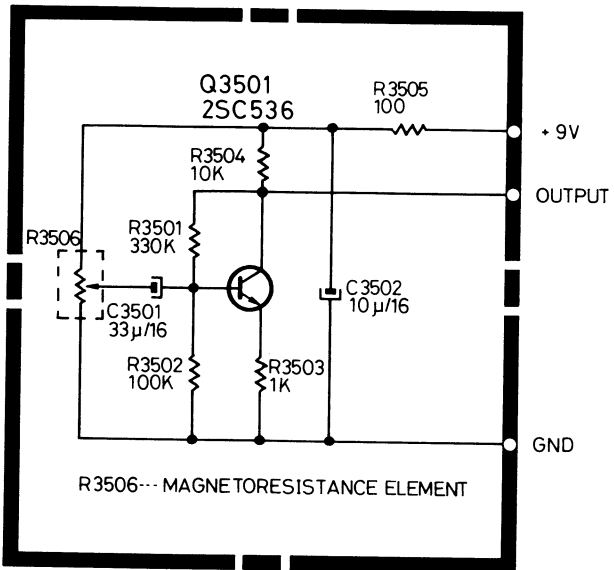
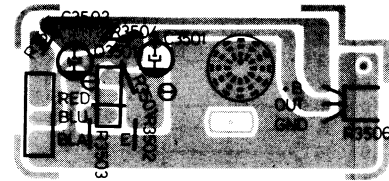
P.C.B. SY-2 OPERATION SWITCH



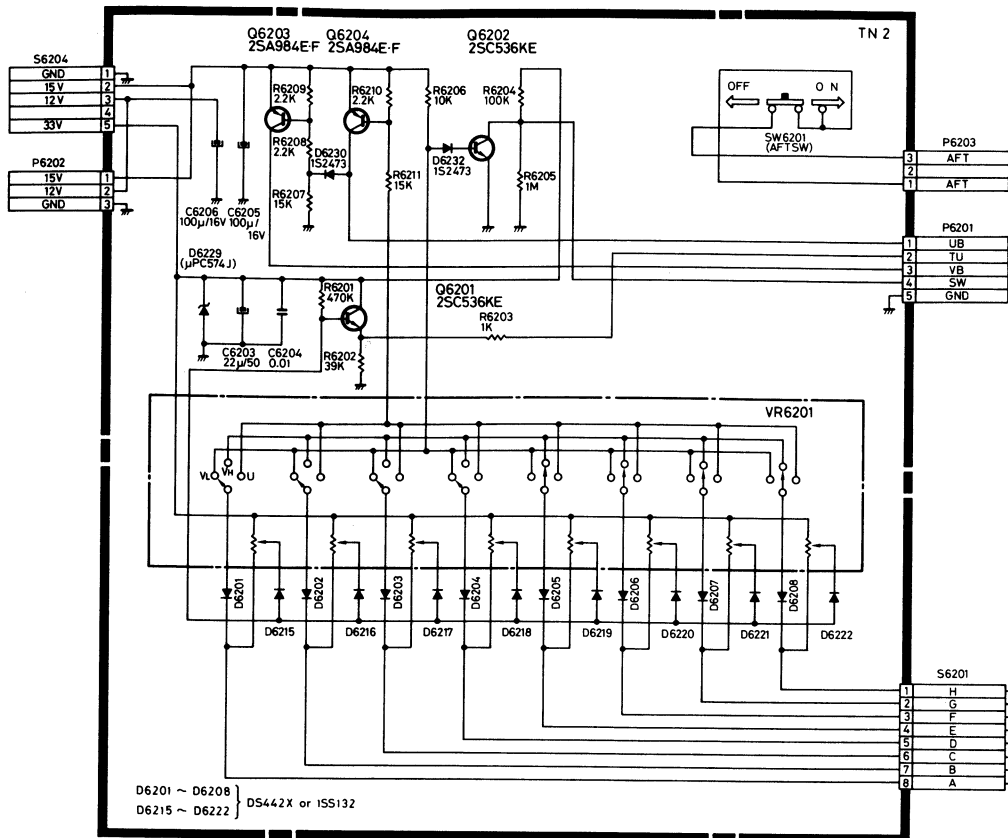
P.C.B. SY-2 OPERATION SWITCH VBS-7500, VBS-7500S
VBS-9900, VBS-9900S



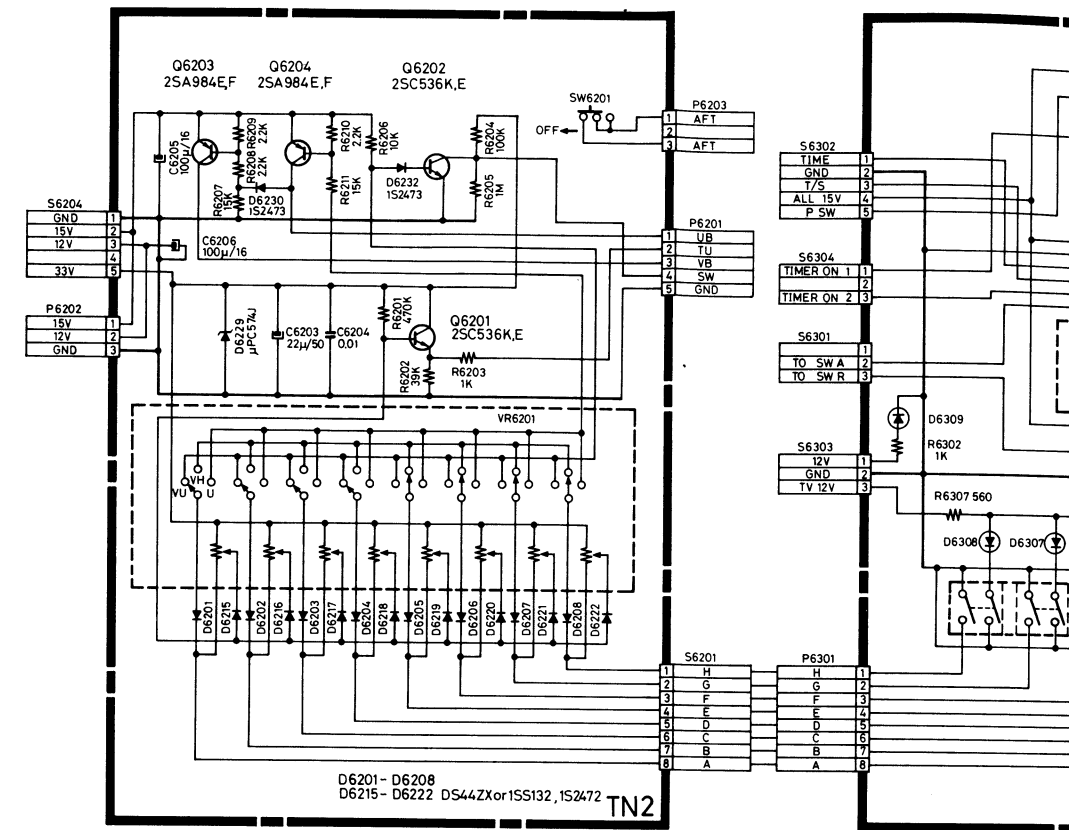
P.C.B. MC-1 REEL SENSOR CIRCUIT



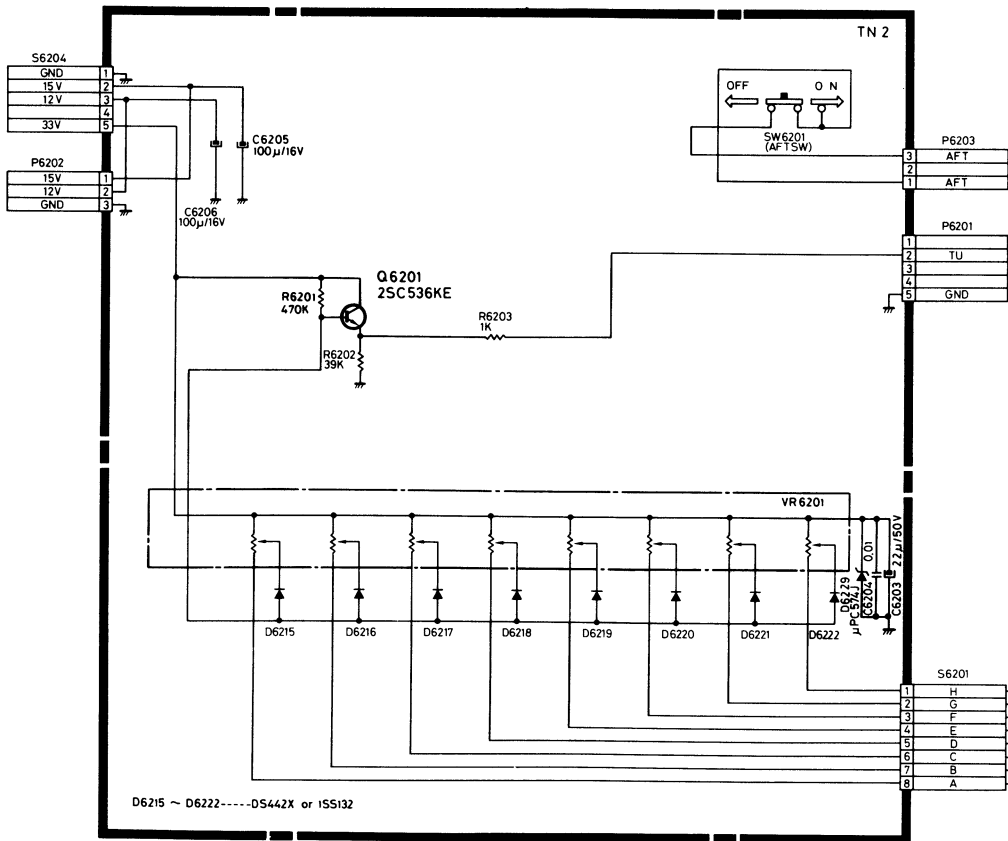
P.C.B. TN-2.3 CHANNEL PRE-SET/SELECT



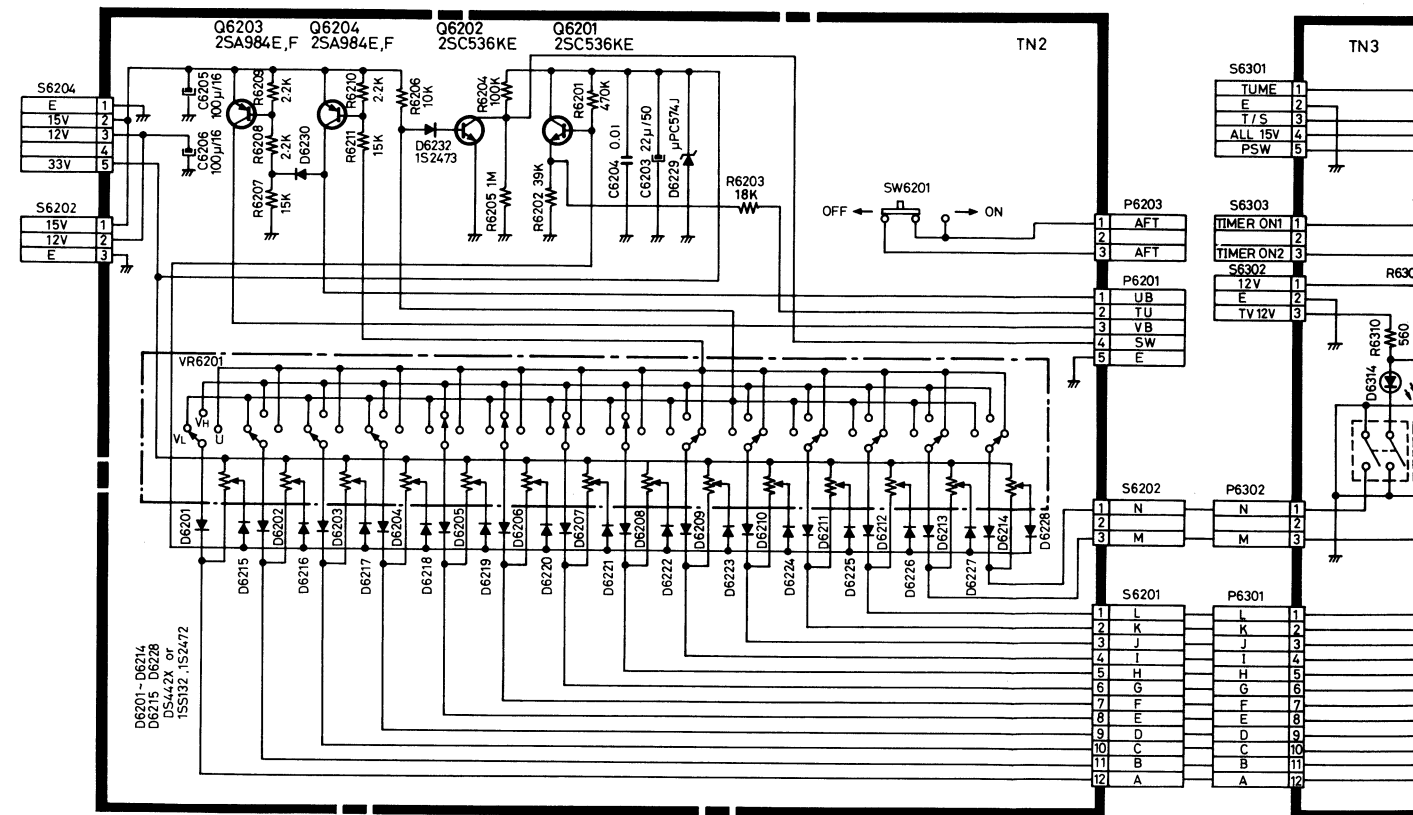
P.C.B. TN-2.3 CHANNEL PRE-SET/SELECT
(Australia, New Zealand)



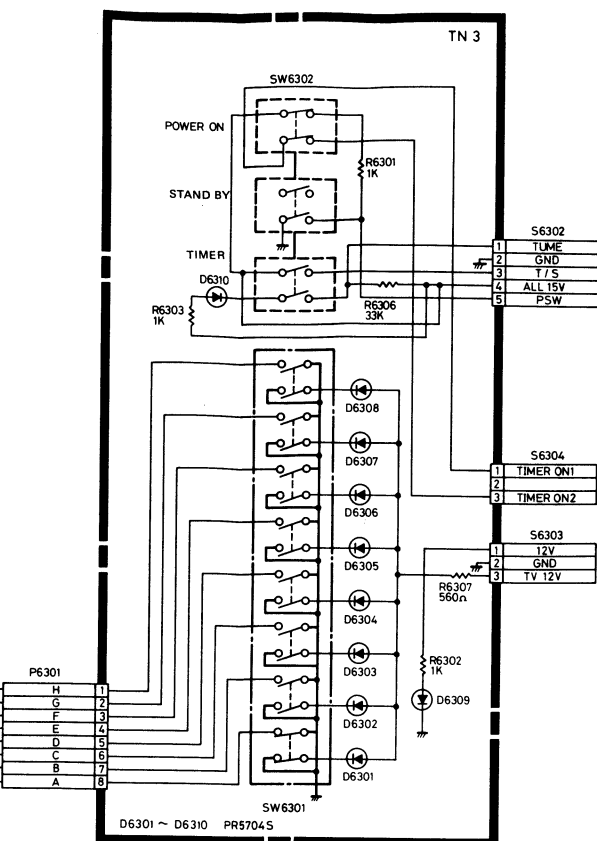
P.C.B. TN-2.3 CHANNEL PRE-SET/SELECT
(U.K, H.K)



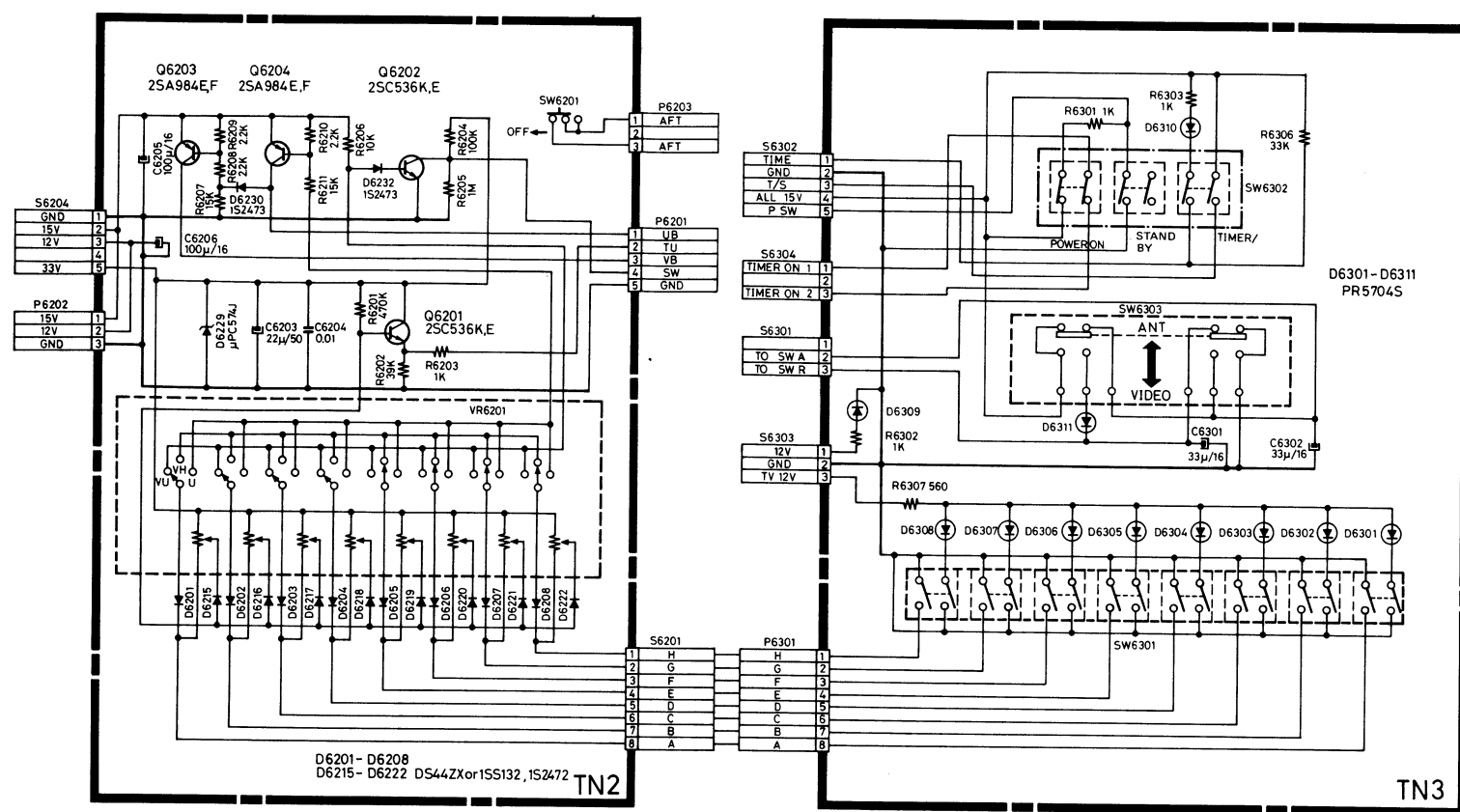
P.C.B. TN-2.3 CHANNEL PRE-SET/SELECT
(VBS-7500S, VBS-9900S, 12CH/V)



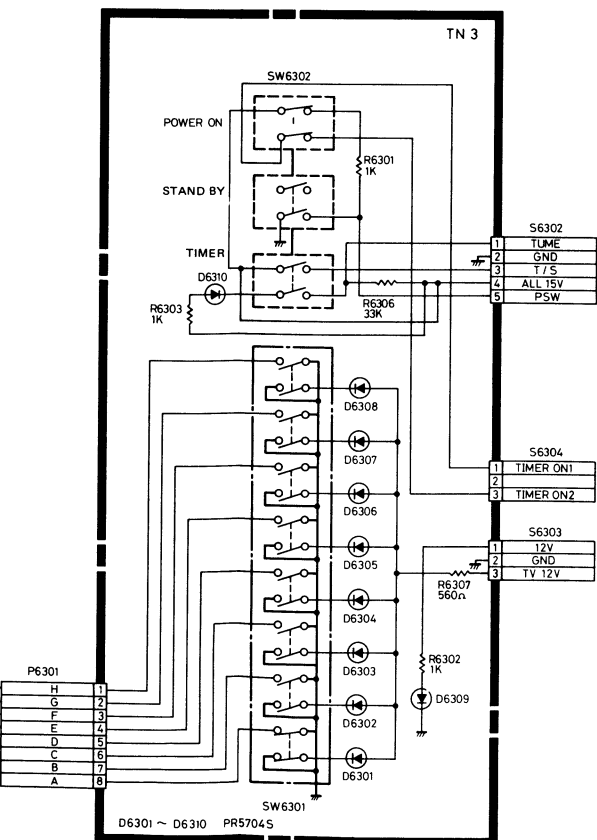
ELECT



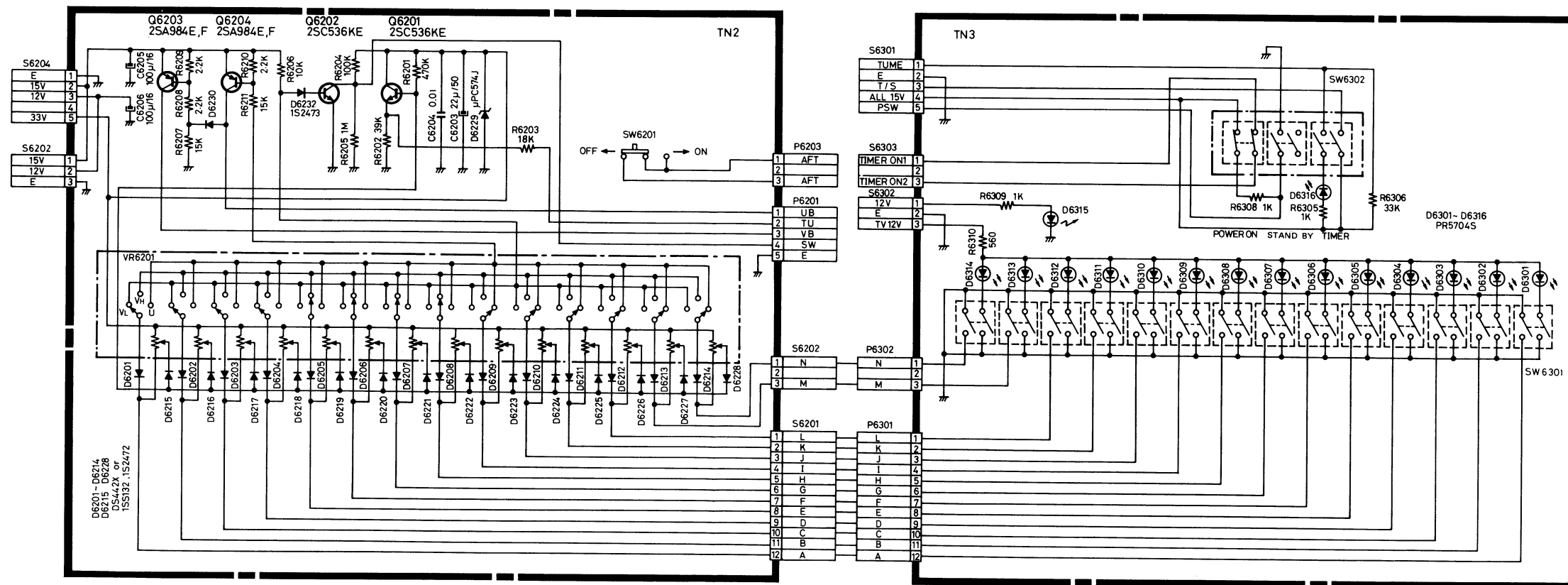
P.C.B. TN-2.3 CHANNEL PRE-SET/SELECT
(Australia, New Zealand)



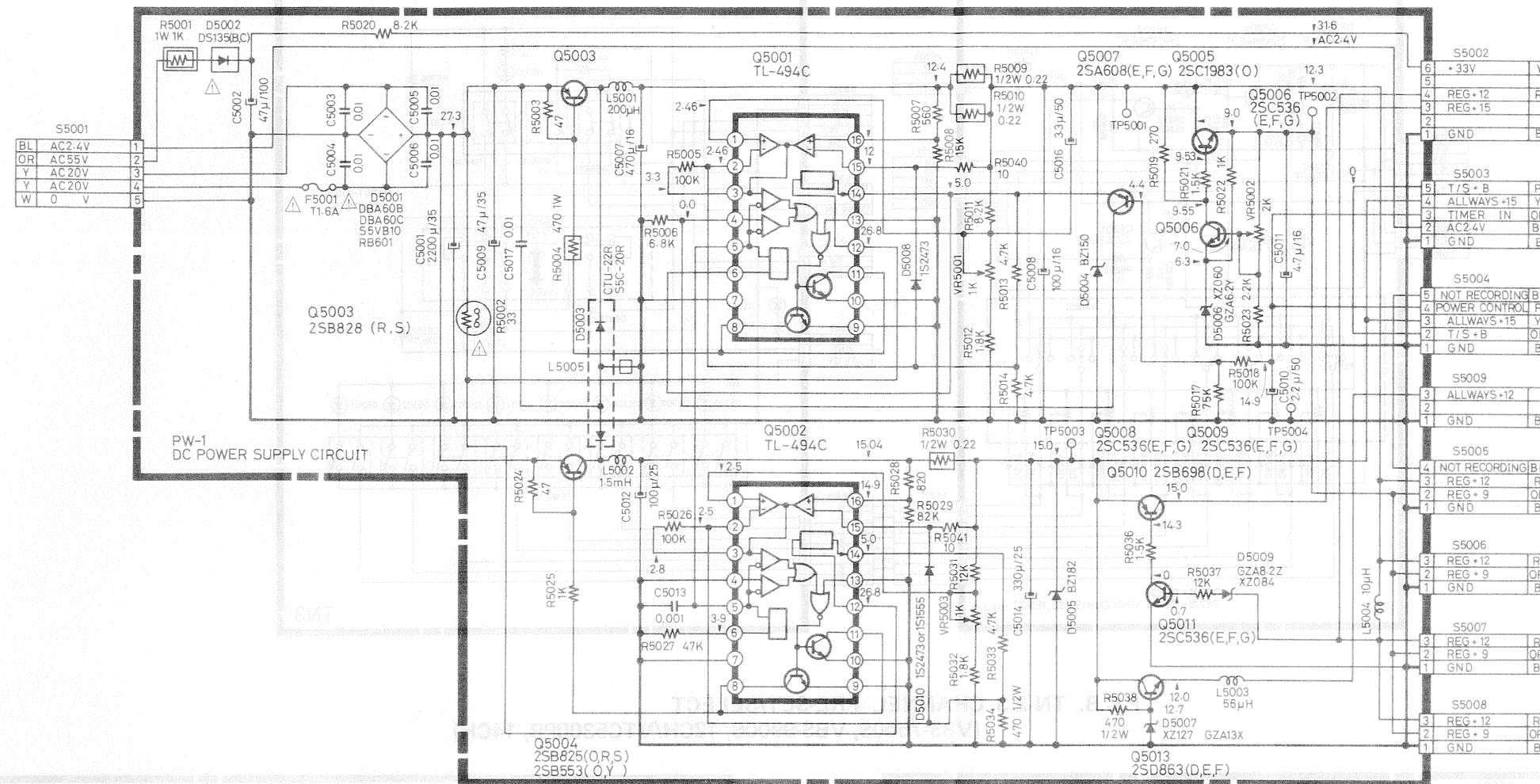
ELECT



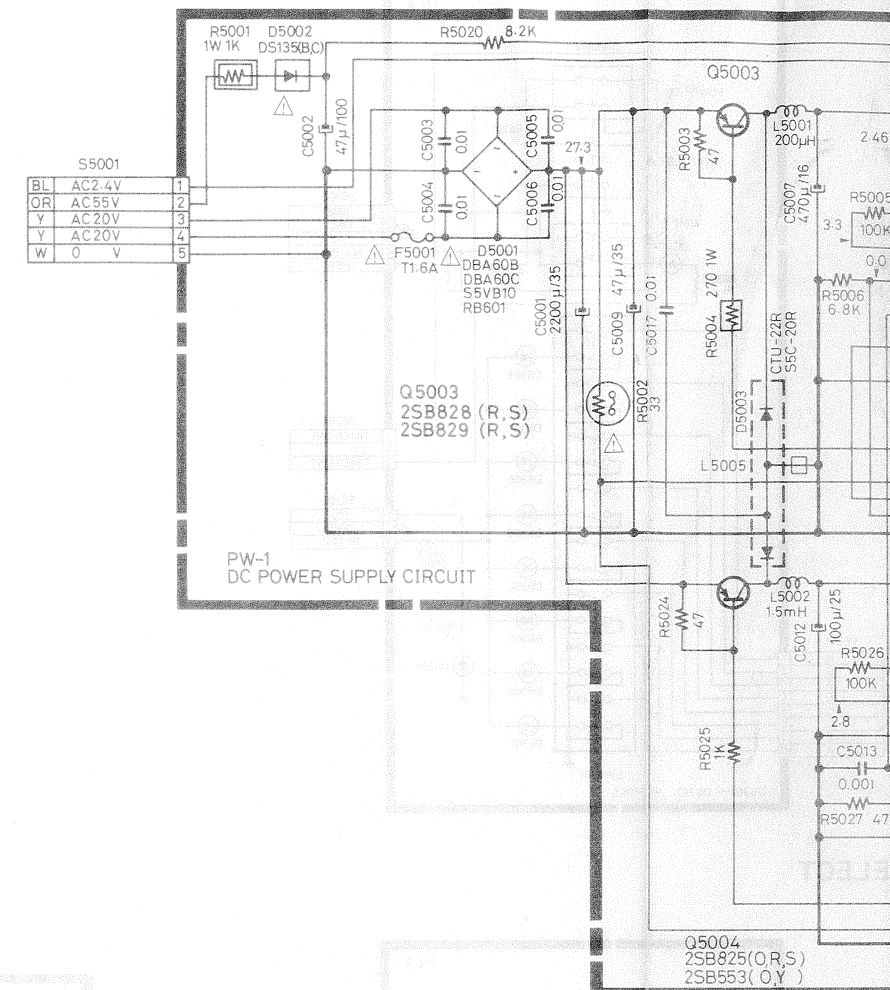
P.C.B. TN-2.3 CHANNEL PRE-SET/SELECT
(VBS-7500S, VBS-9900S, 12CH/VTC5300PB, 14CH)



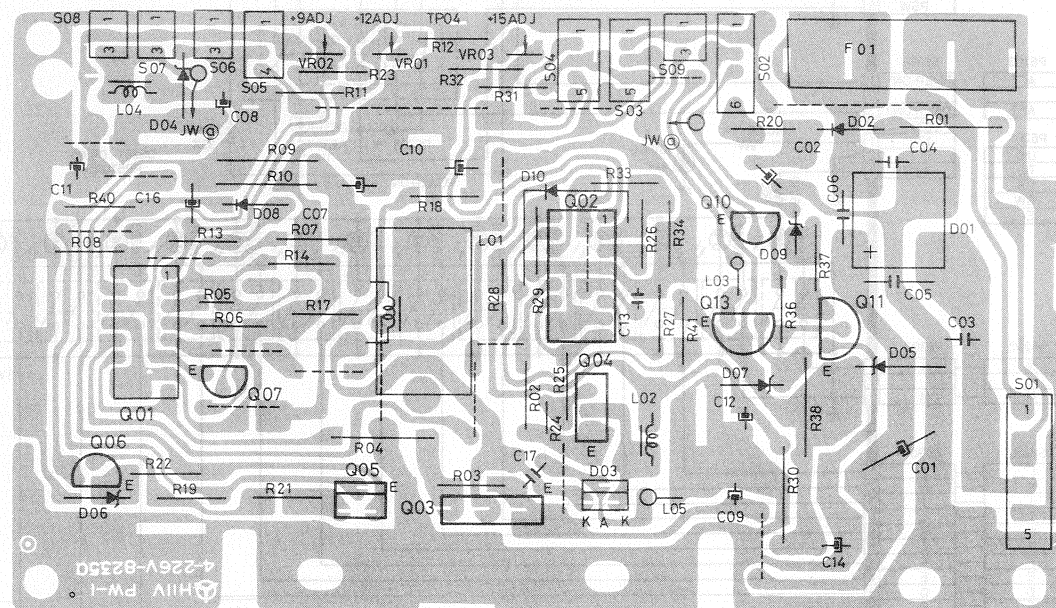
P.C.B. PW-1 DC SUPPLY CIRCUIT



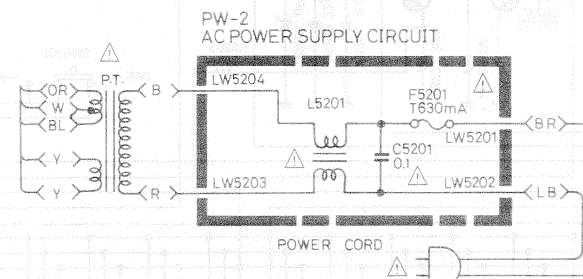
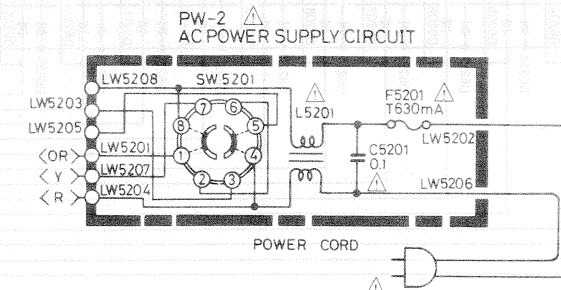
P.C.B. PW-1



P.C.B. PW-1 DC SUPPLY



P.C.B. PW-2 AC SUPPLY CIRCUIT

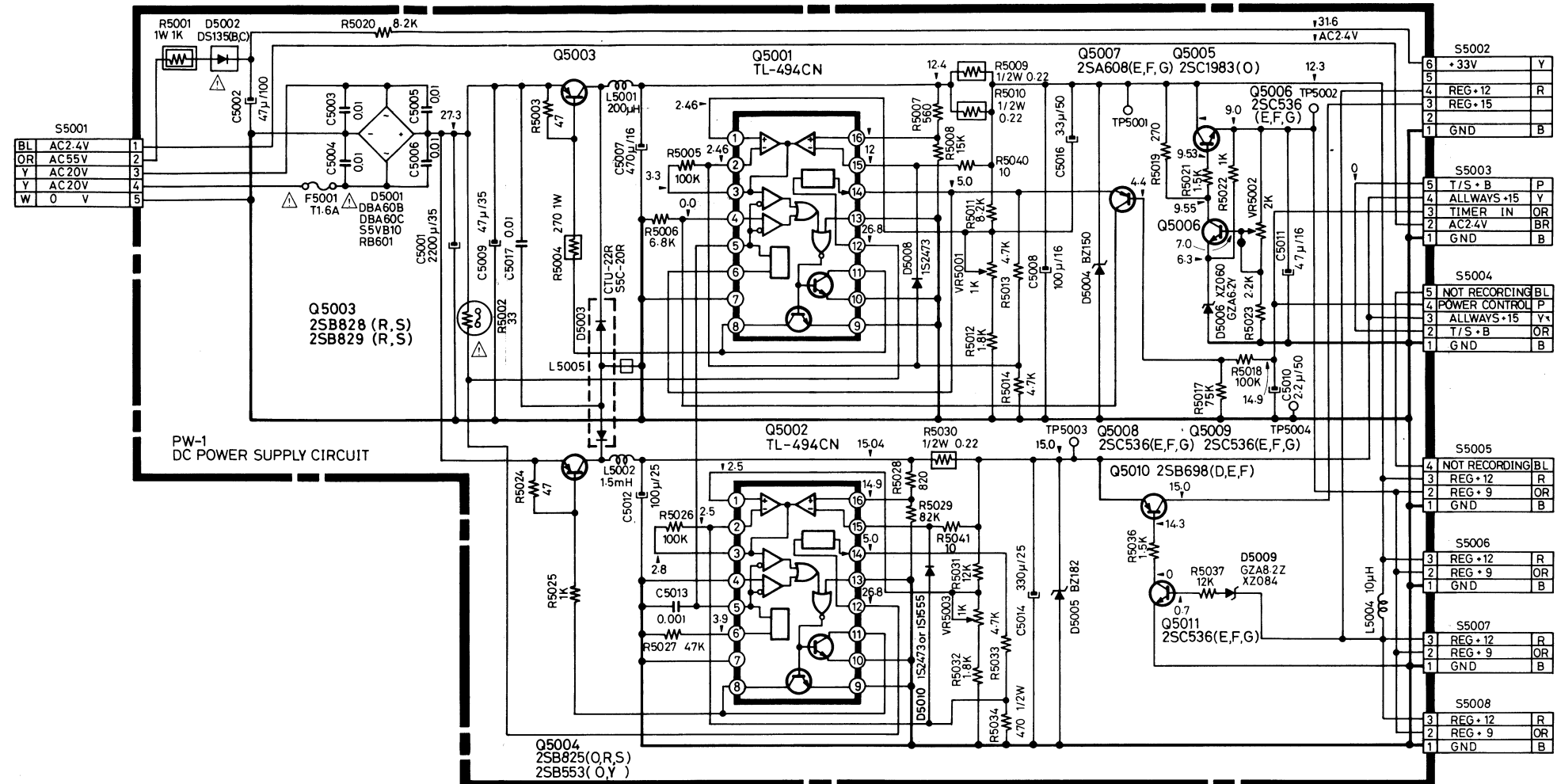
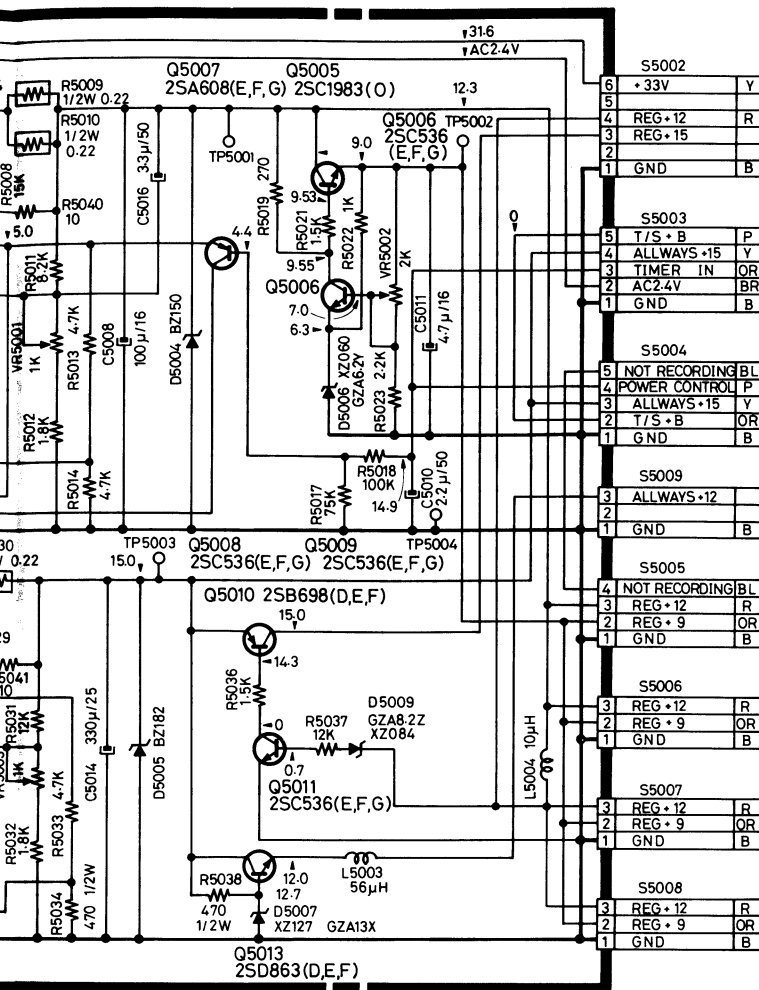
P.C.B. PW-2 AC SUPPLY CIRCUIT
(South Africa, Indonesia)

NOTES:

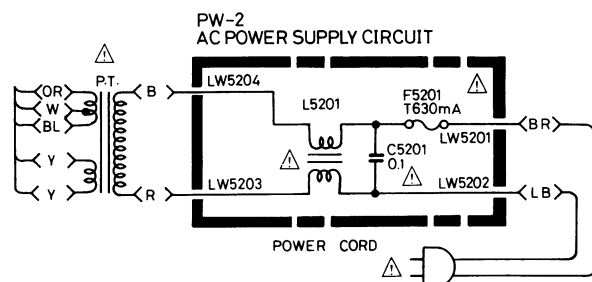
1. All resistance values in "OHMS" unless otherwise noted. (K=1,000 M=1,000,000)
2. All capacitance values in "µfd" unless otherwise noted.
p = pico farad
3. All inductance values in "mH" unless otherwise noted. µ = micro henry
4. Marks indicated in each connector indicate the following color of wire.

B : Black	V : Violet	BR : Brown
R : Red	Y : Yellow	GR : Green
W : White	G : Gray	BL : Blue
P : Pink	LB : Light Blue	OR : Orange

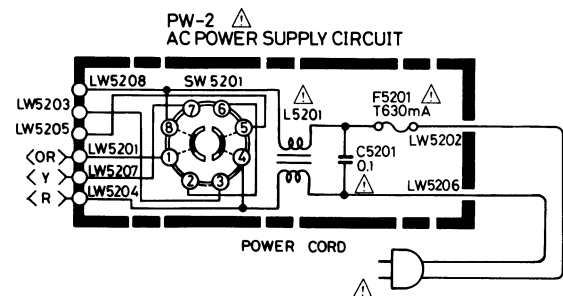
P.C.B. PW-1 DC SUPPLY CIRCUIT
(Australia, New Zeland, Indonesia)



P.C.B. PW-2 AC SUPPLY CIRCUIT



P.C.B. PW-2 AC SUPPLY CIRCUIT
(South Africa, Indonesia)



NOTES:

1. All resistance values in "OHMS" unless otherwise noted. (K=1,000 M=1,000,000)
2. All capacitance values in "μfd" unless otherwise noted. p = pico farad
3. All inductance values in "mH" unless otherwise noted. μ = micro henry
4. Marks indicated in each connector indicate the following color of wire.

B : Black	V : Violet	BR : Brown
R : Red	Y : Yellow	GR : Green
W : White	G : Gray	BL : Blue
P : Pink	LB : Light Blue	OR : Orange

PRODUCT SAFETY NOTICE

PRODUCT SAFETY SHOULD BE CONSIDERED WHEN A COMPONENT REPLACEMENT IS MADE IN ANY AREA OF A UNIT. COMPONENTS INDICATED BY THE SYMBOL Δ IN THIS SCHEMATIC DIAGRAM SHOW COMPONENTS WHOSE VALUE HAVE SPECIAL SIGNIFICANCE TO PRODUCT SAFETY. IT IS PARTICULARLY RECOMMENDED THAT ONLY PARTS SPECIFIED ON THE ATTACHED PARTS LIST BE USED FOR COMPONENT REPLACEMENT DESIGNATED BY THE SYMBOL.

TUNER RF CONVERTER DIAGRAM

